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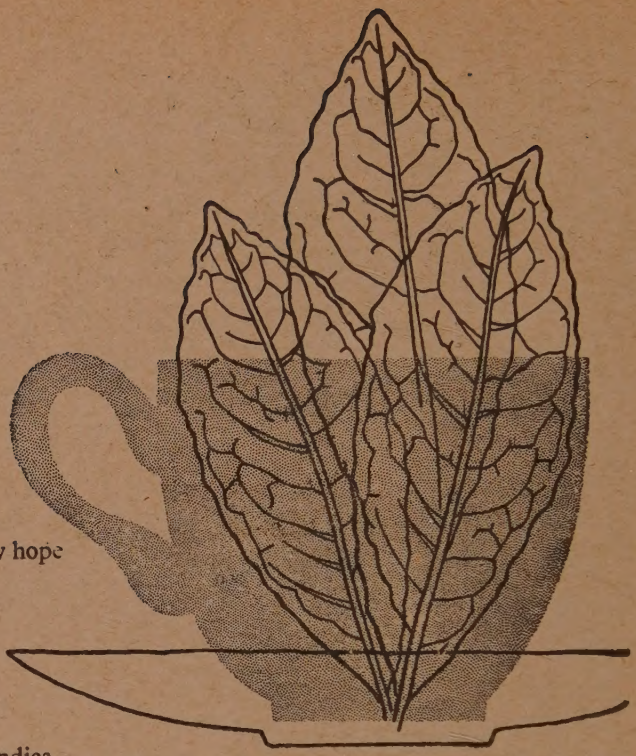

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# TROPICAL AGRICULTURIST

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# EDITORIAL

## Technical Assistance in Agriculture

THE YEARS since the last World War have seen a remarkable development in the field of technical assistance to under-developed countries of the world. This was due to a realization by international groups working for the amelioration of economic conditions that the great disparity of levels of economic development existing between different parts of the world necessitated the provision of such assistance, if the standard of living in these under-developed countries was to be raised even to the minimum which modern social concepts demand.

Accordingly, the United Nations through its Economic and Social Council and the specialized agencies working along with it, resolved in 1949 to provide this necessary assistance in various ways such as by arranging for teams of international experts to visit under-developed countries whose governments requested advice on economic development, awarding fellowships for training experts of such countries abroad, assisting governments to obtain technical personnel, equipment and supplies, etc. In order to make these objectives possible, funds were made available both by the United Nations and the specialized agencies and a programme of expanded technical assistance was started which enabled any under-developed country, at its own request, to obtain assistance within the scope of its provisions. The governments of the latter countries had, on their part, certain obligations to fulfil, but these were only such as would permit of the fullest use being made of the assistance provided. Among the specialized agencies which have contributed their share of technical assistance to these under-developed countries are the Food and Agricultural Organization (F. A. O.), the World Health Organization (W. H. O.), and the International Labour Organization (I. L. O.).

Since 1950 Ceylon has had the benefit of the services of a number of experts from F. A. O. They have been concerned with various aspects of food production, agricultural extension and animal husbandry. Up to date we have had 32 specialists comprising agronomists for dry farming and sugarcane, agricultural engineers, a statistician, agricultural extension experts, plant pathologists, food and rice-processing experts, plant and equipment specialists, forestry advisers, animal husbandry and poultry experts, veterinarians, etc. These experts have been of different nationalities and have remained in the country from six months to two years generally, but in a few exceptional cases their services have been retained for over five years in view of the valuable work they have been rendering during their assignments. Ceylon has also benefited by fellowships which have been awarded by this agency to officers especially selected for the training required.

F. A. O. has also, in accordance with its declared policy, held a number of seminars and training centres in various parts of South-East Asia on subjects of importance to the region, e.g., paddy breeding, soil fertility with special reference to paddy soils, and representatives from Ceylon have attended these. The agency also acts as a clearing-house of technical information on matters connected with food and agriculture.

It is interesting to indicate here that over 5,000 experts have been provided by U. N. O. and the specialized agencies since the programme of technical assistance was started in 1950, and over 8,000 fellowships have been awarded during the period. Though Ceylon has been, for the greater part, a beneficiary under this scheme it has also in a small way contributed its share towards supplying specialists in certain fields of activity. A few of our doctors have gone out to make their contribution in less-developed parts of the world, particularly in preventive medicine, and in agriculture, it is gratifying to note that apart from assistance rendered at various seminars and training centres by two of our specialists, Ceylon has supplied a veterinarian and a leader of an agricultural mission to more under-developed countries. So much for technical assistance under F. A. O. and its related agencies.

To turn now to another organization which has as one of its main objectives the provision of technical aid in various forms to countries in South and South-East Asia for the promotion of their economic development. This organization, initiated in 1950, is known as the Colombo Plan for the Co-operative Economic Development of South and South-East Asia. The object of the Colombo Plan is to supply this technical aid to these countries where ' living standards are distressingly low and poverty, disease and ignorance constitute a challenge to human conscience, let alone world peace and economic progress '. For the purpose of achieving its objectives the Colombo Plan countries have set up a Council for Technical Co-operation with its headquarters in Colombo. As in the case of the United Nations agencies, experts are made available to the countries of the region and technicians trained in countries where such training can best be provided. In addition, aid is provided either in cash or kind for the economic development of the region.

It is interesting to note that during the five years of the existence of the Colombo Plan Technical Co-operation Scheme nearly 1,500 experts have been provided to Asian countries participating in the plan and over 5,000 men and women of the region have been trained in one speciality or another. The major contributory countries are the United Kingdom, Australia, Canada, New Zealand and the United States of America. Recently, Japan has been added to this list. Ceylon has every reason to be thankful to the Colombo Plan Technical Co-operation scheme for the considerable assistance which has been rendered to it by the various participating countries. The article in the current issue of this Journal by Dr. N. Keyfitz, Director of the Colombo Plan Bureau for Technical Co-operation, admirably

outlines the scope and operation of the scheme in respect of technical aid to Ceylon. Australia has recently capped its numerous benefactions under the Colombo Plan by the grant of a sum of £150,000 towards the establishment of a Research Institute for the promotion of agricultural research in the Island, with particular reference to paddy research. This is in keeping with the generous donation of £500,000 by the New Zealand Government towards the establishment of a Dry Zone Research Station at Maha Illupalama. Canada has also added to its numerous contributions under the Plan by providing for the construction and equipping of up-to-date laboratories for the Faculty of Agriculture of the University of Ceylon.

The last and the most recent of the major technical aid agencies which are collaborating in the economic development of the Island is the International Co-operation Administration of the U. S. A. (I. C. A.). By an agreement entered into with the Ceylon Government, this country agreed to provide aid in various fields of economic development to the sum of five million dollars for the 1956 fiscal year. The provision for land development amounted to over a third of this appropriation, but agricultural extension, research and education also received a share commensurate with their needs. The aid under this programme will be utilized in three ways, namely, for the supply of technical personnel in specialized fields of work, the training of local technicians, and the supply of stores and equipment essential for defined objectives. Part of the provision under foreign training and observation will be utilized for sending a high-level team of Ceylonese agricultural and educational officers to the U. S. A. and other countries to study the integrated facilities of agricultural extension, research and education available there. It is anticipated that aid under the I. C. A. scheme will be given in fuller measure in succeeding years.

Before concluding this survey of technical aid to Ceylon under the various agencies, reference may be made to the Rockfeller Foundation which, for several years, has assisted not only under-developed countries but also advanced countries in training personnel in specialities for which there are no facilities locally and in other ways. Recently Ceylon has benefited by a donation of essential physico-chemical equipment from this source.

It will be observed from the foregoing paragraphs that countries like Ceylon are indeed fortunate in that, through the agency of these technical aid schemes for economic development, they can promote within their boundaries fields of activity which hitherto have remained potentially unproductive. But it is incumbent on the recipient countries to take full advantage of the facilities offered under these schemes by the provision of understudies to the foreign experts assigned to a country, by giving full and prompt consideration to the technical advice they receive, by undertaking the sustained effort required for economic development, and by providing the necessary financial support to the projects initiated at their request.

Ceylon has indeed much reason to be grateful to these technical agencies and participating countries for the generous contributions made by them to " ensure the attainment of a higher level of economic and social welfare for its population ". And as this Department has received a fair share of the benefits conferred by them, it is only fitting that the *Tropical Agriculturist,* its official journal, should express its warm appreciation of the practical co-operation which they have extended in such large measure to the solution of the agricultural problems of the Island.

**Errata**

*Tropical Agriculturist, Vol. CXI, No. 4, 1955*

P. 267–275—*Hirigala* should read *Hiriyala*

P. 268, first column, line 24—*Maoya* should read *Meeoya*

P. 268, second column, line 13—*kariya* should read *kiya*

P. 268, second column, line 34—20% should read 2%

P. 270, first column, line 2—*V. S. Perera* should read *V. G. Perera*

P. 273, second column, line 6—*Gonewatte* should read *Ganewatte*

P. 273, second column, line 9—*Dewala* should read *Demala*

# ARTICLES

## The Colombo Plan with Special Reference to Ceylon's Food

N. Keyfitz, Director, Colombo Plan Bureau of Technical Co-operation

*Received 12.8.56.*

The colombo plan is the sum of the development plans of the countries of South and South-East Asia. It has always been clear that these are national plans and the effort that would go into implementing them would largely be national effort, but the statesmen who gathered in 1950 to consider economic development saw that the citizens of a country are likely to be stimulated by the sense that other countries are interested in their progress, and that there were possibilities of useful interchange of technical assistance and capital aid. In the past six years substantial benefits have been realized, and the Colombo Plan has become a symbol of co-operation among free peoples. Not only is the Plan as a whole worked out by individual countries, but the co-operation which is an important part of it is negotiated in every instance between a requesting country and a donor country.

It is a happy feature of the Plan that many of the countries of the area are both donor and receiving. Ceylon, for example, is providing training for Burmese and Malayans in the organization and administration of co-operatives. Village workshops for the production of brick and tile in Ceylon are being organized by an expert from India. India again is providing a superintending irrigation engineer for the Gal Oya multi-purpose project. Ceylon is training Asians in engineering technology at the Gal Oya Technical Training Institute, and a group of Vietnamese local health personnel in a project supported by the United States. However, since the partners outside Asia have the largest available accumulation of skill and capital, the greater part of the Colombo Plan assistance to countries of the area still comes from the west.

Under the Technical Co-operation Scheme of the Colombo Plan places are provided for trainees from the area, and experts and equipment are sent to the countries of the area. With sound choice of the fields of activity, skilful selection of trainees and of experts, and provision of the conditions necessary for the effective work of experts and ex-trainees, the Scheme means much for development.

There are at the moment in Ceylon 68 experts brought out under the Scheme, of whom 31 come from Canada, 16 from Australia, 9 from the United Kingdom and 7 from New Zealand. The ideal project is of a self-liquidating character, in the sense that Ceylonese carry on after the foreign expert has left, rather than in the sense that the project terminates. Thus the fisheries biologist who has come to Ceylon under Colombo Plan does not find the places where the fish are, and their habits, and set these

results down for all later generations of fishermen. He rather develops a method of investigation, obtains some preliminary results, and trains a Ceylonese to continue the work—perhaps to do it better. To help raise the level of skill of Ceylonese, and so facilitate their independent work in the future, is the object of all technical assistance projects going forward here.

Through its agriculture, Ceylon has achieved just about the highest standard of living in Asia. National income per capita is not an accurate measure of this because it is biased towards market production as against direct production for subsistence, but it provides a rough indication. Ceylon's average in 1953 was Rs. 540 against India's Rs. 285. It might be argued that it is sufficient to hold this high level, and that further development effort is unnecessary, but for several reasons it is impossible to take this view. The most obvious is that democracy and nationalism in Ceylon are associated with aspirations not satisfied by present income. Secondly, an economy based on the export of tea, rubber and coconuts is subject to much fluctuation, and diversification is a means of defence against undesirable repercussions of outside market changes. Thirdly, because of technological change the products and methods developed in one era may not serve in another. In rubber, for instance, synthetic is a new market factor that must be faced. Even if synthetic is disregarded on the ground that natural has stood up well and world sales in 1954 were 70% greater than 1937-39, the competition of natural from other countries demands increased efficiency in Ceylon. Fourthly, population is growing rapidly, and an increase in food production is required if people are to eat as well as they have. More than 300,000 births are each year balanced against less than 100,000 deaths, so that natural increase is over 200,000 or 2½% of the population. Official figures for national income in 1951 are Rs. 4,619 million and in 1954 Rs. 4,772 million. The apparent increase, however, compares with a growth of population from 7,742,000 in 1951 to 8,385,000 in 1954.

There are features of agricultural practice in Ceylon as elsewhere which have been described as inefficient and indeed irrational. I prefer to think of some at least of the practices as rational enough, but aimed at short-run objectives. Thus the individual peasant regards his coconut trees as permanent and the benefits of replanting as distant. The individual may adopt short-run objectives but the nation cannot afford them; replacement of old trees by younger ones is essential for effective competition in world markets. It is in this weighing of long-term consequences that the outside expert can be useful, if he combines an intuition of market prospects with knowledge of the local techniques and conditions of production. He can even help in implementation by suggesting a change in the conditions which frame the calculations of the individual peasant so as to align these calculations with the long-term interests of the nation. In the replanting problem two of the theoretical possibilities are taxes on old trees or subsidies on new ones; Ceylon has for some time maintained a subsidy in the form of sales of seedlings below cost.

However, the task is only partly one of changing the framework in which the farmer makes his decisions; it is partly a matter of educating him to his own

interest within the existing framework. This means agricultural extension work on a large scale. Foreign experts cannot conduct such work themselves—because they are few and do not speak the language if for no other reasons. But they can train Ceylonese extension workers along lines that have been successful both here and abroad, and this is an important part of technical assistance. A lecturer in botany, a professor of agriculture and an adviser on agricultural education have all worked in Ceylon under the Colombo Plan Technical Assistance Scheme.

Colombo Plan technical assistance in the field of agriculture has included support for mechanization. Tractors have been used in the opening up of new lands and Ceylon's methods of forest clearing are a model for the region. Experts have included managers for tractor stations in which equipment is maintained as well as a man working on the mechanization of tea cultivation. A Commissioner on Alienation of Crown Land has been helping on legal problems involved in adding to the land in use for food production. An expert in soil conservation has dealt with problems of productivity of existing soils. Attention to livestock includes provision of an adviser on veterinary science and a sheep-raising expert. Specialized crops on which outside technicians have worked are silk, rice, citrus and honey.

Ceylonese have been given training abroad in all of the fields mentioned above as well as in tobacco, rubber research and poultry. Equipment was provided in support of tea and rubber research, and a poultry unit, threshers, and hatching eggs have also been contributed.

The assistance described above has been given under the Technical Co-operation Scheme. In addition a very substantial amount of capital aid has been contributed by Ceylon's Colombo Plan partners. At an early stage there was agreement that support of food production was probably the most useful form which this outside aid might take.

The United States has very recently entered into agreements to contribute to agricultural extension, research and education. This will include advisers on methods and techniques for extension work, advisers on training curricula for extension workers and research to back-stop extension. A second major project is irrigation and land development in the Dry Zone. The U. S. is to furnish earth-moving equipment and maintenance and operation specialists for this equipment. It will also provide equipment for a maintenance shop.

In the Dry Zone, control of malaria has greatly increased Ceylon's potential food supply. Cultivation was made possible in ancient times by an elaborate system of tanks which provided a perennial supply of water. Australia has been associated with the scheme to restore three tanks at Padawiya, Pavatkulam and Vavunikulam which will open up a total of 24,500 acres for rice cultivation. Australia contributed 200 tractors to help in the mechanization of agriculture and so increase food production.

Apart from developing land by major and minor irrigation projects, Ceylon has introduced four schemes to assess the possibilities of dry farming on unirrigable land in the Dry Zone.

New Zealand made a grant for buildings and equipment towards the dry farming research station at Maha Illupalama. Nearly all the equipment has arrived on the site and construction is well advanced. The United Kingdom is training one of the engineers engaged on the design and development of animal-drawn implements for highland cultivation.

Canada has made a gift of flour whose sale has generated counterpart funds for local construction costs of rural roads, and of a building for the Faculty of Agriculture. She has presented a refrigeration and by-products plant at Mutwal, a trawler, and a fisheries harbour, as well as pest control and sprinkler and lift irrigation units, and veterinary vans.

# Row Sowing of Germinated Paddy—the Solution to the Peasant Cultivator's Difficulties

A. L. JOHNPULLE, Agricultural Officer, Department of Agriculture, Ceylon

*Received 14.6.56.*

OF A TOTAL of about 769,716 acres cultivated under paddy in the Island in *maha* less than 10 per cent. is transplanted and 3 per cent. in *yala* on about half that extent cultivated. Transplanting as a means of increasing yields of paddy has been persistently advocated by the Department of Agriculture both by propaganda talks and actual demonstrations in cultivators' fields during the past several years. Of transplanting demonstrations alone either singly or combined with other operations such as weeding, application of fertilizers, &c., there have been several thousands carried out so far. Yet the headway made with this method of improving yields has been very slow.

In the Southern Division the acreage transplanted of a total of 128,847 acres cultivated was 2,861 in *maha* 1955-56 or 2.22 per cent. In *yala* 1955 of a total cultivable extent of 123,529 acres only 1,205 acres or 0.97 per cent. was transplanted. Worked on a possible transplantable extent of 43,657 acres in *maha* and 39,951 acres in *yala*, the extents transplanted in *maha* 1955-56 and *yala* 1955 represent 6.6 per cent. and 3.05 per cent. respectively. The number of demonstrations carried out on transplanting singly or combined with other operations during the past few seasons is as follows :—*yala* 1952—172 ; *maha* 1952-53—228 ; *yala* 1953—804 ; *maha* 1953-54—1,198 ; *yala* 1954—1,133 ; *maha* 1954-55—1,118 ; *yala* 1955—858 ; *maha* 1955-56—990.

Yet, in spite of the determined effort made during the past eight seasons to popularize transplanting, all that was achieved was the raising of the transplanted extents from 1,359 acres in *maha* 1952-53 to 2,861 acres in *maha* 1955-56 and from 471 acres in *yala* 1952 to 1,205 acres in *yala* 1955.

In advocating this method of stepping up of yields we have failed in appreciating the difficulties of the peasant cultivator. Although he is convinced that transplanting, if properly carried out, will increase his yields, there are factors beyond his control which will not permit him to do it. Chief among these are (*a*) the uncertainty of the weather : nurseries cannot sometimes be raised or, if raised, have to be abandoned and the crop sown broadcast because the subsequent rains have failed or are too late to permit transplanting to be done, (*b*) the high cost involved which he, by experience, knows is far above the Rs. 40 to Rs. 50 per acre advocated, (*c*) the non-availability of manpower, (*d*) the attention necessary to protect the nurseries from cattle damage.

These problems received the close attention of the writer when after about two years' work in the Division it was realized that, unlike in the Kandyan areas, much headway could not be made in transplanting in the low country areas.

The advent of the Japanese inter-cultivator, which the writer was the first to test early in 1954 with a view to reducing weeding costs on transplanted paddy, suggested greater possibilities of its exploitation on broadcast paddy. This idea was tested out for the first time in the Island by the writer by sowing germinated paddy in rows in *yala* 1955 both under farm conditions and in cultivators' fields so as to permit inter-cultivation being done. The results were spectacular indeed in spite of the errors made with regard to spacing, period of germination of the seed paddy, quantity of the seed paddy used, &c.

In that season the preliminary trials carried out under cultivators' conditions were in two plots—one in Matara District and the other in Hambantota District. The yield per acre with a spacing of 12 inches was 54 bushels each. Germinated paddy was sown in rows.

The trials undertaken in the farms consisted of one plot (1/5 acre in extent) at Mapalana Farm and 6 plots ($\frac{1}{4}$ acre each in extent) at Ambalantota Paddy Station. In the Mapalana plot a spacing of 12 inches between rows was given but within the rows seeds were dropped about 6 inches apart. Two intercultivations with the Japanese weeder were given. The plot received the same manurial treatment per acre as the rest of the fields, viz., $\frac{1}{2}$ cwt. sulphate of ammonia, $1\frac{1}{2}$ cwt. superphosphate and $\frac{1}{2}$ cwt. muriate of potash. The yield was 45 bushels per acre.

At Ambalantota, two spacings were given—12 inches and 10 inches—with two varieties of paddy, viz., *Rathkarayal* and *Suduheeneti ICPY* 15. The control plots were transplanted 12 inches × 4 to 6 inches. All plots received a manure mixture of $\frac{1}{2}$ cwt. concentrated superphosphate and $1\frac{1}{2}$ cwt. sulphate of ammonia in three doses. Three inter-cultivations were given. The *Suduheeneti* row sown plot was affected by rains immediately after sowing. Germinated paddy was sown in rows. The cost of cultivation and yields were as follows :—

**Ambalantota—Yala 1955**

| | *Yield Per Acre Bushels* | *Cost Per Acre Rs.* |
|---|---|---|
| *Variety—Rathkarayal* | | |
| Transplanted (12″ × 4″–6″) | 61 | 296 |
| Row sown 10″ | 49 | 256 |
| Row sown 12″ | 46 | 246 |
| *Variety—Suduheenati ICPY 15* | | |
| Transplanted (12″ × 4″–6″) | 36 | 288 |
| Row sown 10″ | 40 | 266 |
| Row sown 12″ | 38 | 246 |

Encouraged by the results, the method was advocated among cultivators in *maha* 1955-56. The response was very satisfactory. Thus 103 acres were row sown in the Galle District, 81 acres in Matara District and 81 acres in Hambantota District. Demonstrations were also carried out in the three Districts in cultivators' fields. Some of the yields obtained from the latter are shown in Table I.

TABLE I

| Name of Field | Village | Plot Size (Acres) | Yield Per Acre Demon. Plot Bush. | Yield Per Acre Broadcast Con Plot Bush. |
|---|---|---|---|---|
| *Galle District* | | | | |
| Gambedda | Ihala Keembiya | ½ | 56 | 32·5 |
| Delgahakumbura | Ihala Lelwela | 7/16 | 61 | 42·5 |
| Millagahaduwa-addara | Ihala Lelwela | ½ | 60 | 41 |
| Thelegahakumbura | Thoragampitiya | ½ | 38 | 22 |
| Thelekumbura | Kodagoda | ¼ | 54 | 21 |
| Moratuduwagura | Kodagoda | ¼ | 23 | 14 |
| Sitakandura | Walpola | ¼ | 48 | 16 |
| Udumulla | Hikkaduwa East | 1 | 48 | 28 |
| Potadeniya | Kalupe | 1 | 40 | 28 |
| Delgaha-addara | Maha Ehagoda | ½ | 37 | 24 |
| Wattekumbura | Rekadahena | 2½ | 42 | 15 |
| Diwela | Pilana | ¼ | 48 | 30 |
| Doleliyadda | Halgasmulla | ½ | 58 | 26 |
| Panselekumbura | Yatiyala | ½ | 60 | 25 |
| Panselekumbura | Yatiyala | ¼ | 62 | 32 |
| Walakumbura | Pannegamuwa | ¼ | 56 | 32 |
| Kirimetiwala | Dorape | ¼ | 52 | 32 |
| Goda-amuna | Heenetigala | ¼ | 64 | 28 |
| *Matara District* | | | | |
| Mahakumbura | Kirilapone | 1 | 44 | 14 |
| Illukketiya | Kirilapone | 1 | 47 | 26 |
| Miniranwala | Ginneliya | 1 | 64 | 17 |
| Sapugahadeniya | Ginneliya | 1 | 46 | 21 |
| Parakumbura | Andoluwa | ½ | 34 | 12 |
| Mahakumbura | Mawarala | ½ | 34 | 15 |
| Wijesindeniya | Rotumba | ½ | 38 | 16 |
| Mullekumbura | Puhulwella | ½ | 60 | 36 |
| Gorakedeniya | Puhulwella | 1 | 64 | 34 |
| Nawaraketiya | Hettiwela | 1 | 68 | 30 |
| Bokalekumbura | Godagama | ½ | 67 | 23 |
| Kirillagahadeniya | Wewahamanduwa | ¼ | 60 | 45 |
| Lebbegeliyadda | Godagama South | 2 1/8 | 75 | 35 |
| Moyagamakumbura | Godagama South | ¼ | 48 | 28 |
| Karagahakumbura | Hettetiya | ¼ | 52 | 25 |
| Punchiwewa | Wewaehialagoda | ¼ | 45 | 32 |
| Siyambalamulla | Wewaehalagoda | 1 | 48 | 32 |
| Puwakgahakumbura | Wewaehalagoda | ¾ | 40 | 24 |
| *Hambantota District* | | | | |
| Dahasyaya | Helambagaswela | 1½ | 81 | 34 |
| Medakumbura | Medagama | ¼ | 79 | 50 |
| Malttangakumbura | Kariwele | ¼ | 88 | 46 |
| Palugahakumbura | Beragama | ½ | 89 | 48 |
| Moragedepela | Godakumbura | ¼ | 89 | 17 |
| Halpathkumbura | Ambala | ¼ | 73 | 20 |
| Polgahadeniya | Ovilana | ¼ | 46 | 28 |
| Hevenekkumbura | Galagama | ¼ | 52 | 21 |
| Kiringadeniya | Maha-heela | ¼ | 78 | 23 |
| Paragawakkumbura | Lunama | ½ | 62 | 42 |
| Kandiyagawakumbura | Manneliya | ¼ | 54 | 36 |
| Wattegawakumbura | Kiula | ¼ | 58 | 40 |
| Kandabodakumbura | Pallegama | ½ | 56 | 32 |
| Mullekumbura | Deniya | ½ | 48 | 36 |

The Senior Agricultural Assistant, Hambantota, adopted this method in 4 acres of his own fields at Hakmana and obtained an average yield of 80 bushels per acre where previously it was about 30 bushels per acre.

At the same time further tests were undertaken in *maha* 1955-56 at Labuduwa Farm and Ambalantota Paddy Station.

At Labuduwa Farm trials were carried out with the paddy varieties *Mas M 24, Murungakayan 302* and *Sulai.* A spacing of 10 inches between rows and 1—2 inches within the rows was given. The seed paddy was soaked for 24 hours and kept under pressure to germinate for a further 24 hours before sowing was done. It was found that 3/4 bushel of *Mas M 24* was sufficient to row sow one acre. In the case of the other two varieties a little over one bushel was used as seed rate. It was further found that with about 2 days experience one man and four women could row sow one acre in a day. One acre each was used for the trial plot and the control. The latter was transplanted 10 inches between rows and 4—6 inches within rows in the case of *Mas M 24* and *Murungakayan 302,* and broadcast and crop harrowed in the case of *Sulai.* All plots received a fertilizer dressing of 1½ cwt. saphos, ½ cwt. sulphate of ammonia and ½ cwt. muriate of potash prior to broadcasting, row sowing or transplanting, and ¾ cwt. sulphate of ammonia about 5 weeks after planting. Two intercultivations were given with the Japanese weeder in the case of row sown and transplanted plots. There was a severe outbreak of *Piricularia* on the row sown *Mas M 24* and *Sulai* and a Silver Shoot attack on the row sown *Murungakayan 302.* The latter was also damaged by floods. These reduced the yields. The cost of cultivation and yields obtained were as follows :—

**Labuduwa—Maha 1955-56**

| | *Yield Per Acre Bushels* | *Cost Per Acre Rs.* |
|---|---|---|
| *Variety—Mas M 24* | | |
| Row sown 10″ (1 acre)* .. | 67 .. | 277 |
| Transplanted (10″ × 4″–6″–1 acre) | 84 .. | 421 |
| *Murungakayan 302* | | |
| Row sown 10″ (1 acre)† .. | 46 .. | 286 |
| Transplanted (10″ × 4″–6″–1 acre) .. .. | 53 .. | 347 |
| *Sulai 27614* | | |
| Row sown 10″ (1 acre) .. | 25 .. | 252 |
| Broadcast (1 acre) .. | 31 .. | 294 |

* Severe *Piricularia* attack.
† Severe Silver Shoot attack and damage caused by floods.

At Ambalantota Paddy station, three varieties of Paddy, viz., *Pokkali, Sinnanayan 398,* and *Rathkarayal* were used. The spacing generally given to the row-sown plots was 10 inches but two plots were given a spacing of 8 inches. The plots were distributed in various blocks on the farm but unfortunately block C (12 acres) suffered severely from water shortage with the result all yields from this block were low and these reduced the average yield of the station. In all cases except one, after the normal soaking of the seed paddy for 24 hours it was germinated under weight for a further period of 24 hours. In the exception, seed was allowed to germinate for 36 hours. Artificial fertilizers at the rate of 1½ cwt. sulphate of ammonia and ½ cwt.

concentrated superphosphate per acre were applied to each plot whether row sown, transplanted or broadcast. The Japanese weeder was used three times in the row sown and transplanted plots. Details of yields obtained and the cost of cultivation are shown in Table 2.

**TABLE 2**

**Ambalantota—Maha 1955-56**

| *Treatment* | *Acreage* | *Yield Per Acre Bushels* | *Cost Per Acre Rs.* |
|---|---|---|---|
| BLOCK G—VARIETY—POKKALI | | | |
| Transplanted 10″ × 4″—5″ | 1 | 87 | 346 |
| Row sown 10″ | 1 | 69 | 249 |
| Broadcast | 5 | 60 | 276 |
| BLOCK C *—VARIETY—SINNANAYAN 398 | | | |
| Row sown 10″ | 1 | 35 | 249 |
| Broadcast | 3 | 35 | 296 |
| BLOCK C * VARIETY—RATHKARAYAL | | | |
| Row sown 8″ | 1 | 40 | 256 |
| Broadcast | 4½ | 31 | 287 |
| BLOCK D—VARIETY—SINNANAYAN 398 | | | |
| Row sown | 1 | 60 | 268 |
| Transplanted 10″ × 4″—5″ | 7 | 57 | 328 |
| Broadcast | 2 | 45 | 296 |
| BLOCK E—VARIETY—RATHKARAYAL | | | |
| Row sown 8″ | ¾ | 59 | 256 † |
| Row sown 10″ | 1 | 37 | 242 ‡ |
| Transplanted 10″ × 4″—5″ | 3½ | 54 | 324 |
| Broadcast | 2 | 32 | 234 § |

*Note.*—* General yield of block C was very poor due to shortage of irrigation water.

† Preparatory implemental tillage could not be done. All such tillage was done with the mammoty, the actual cost of such tillage being Rs. 115 compared to an average cost of Rs. 77 in the case of other fields.

‡ Yields low due to outbreak of thrips and stem-borer.

§ Expenditure less because normal hand-weeding could not be given due to shortage of water.

It will be noticed that where row sowing of germinated paddy has been adopted an increase in yield over the broadcast paddy has been effected but what is more important is that there has been a general reduction in the cost of cultivation by over Rs. 25 per acre, a substantial saving from the point of view of the peasant cultivator.

Consequent on the *maha* 1955-56 demonstrations held in cultivators' fields, there was a sharp increase in the acreage row sown in *yala* 1956. At the time of writing 970 acres have been actually done. The acreage would have been considerably more but for the fact that several tracts throughout the Division were not cultivated in *yala* 1956 owing to the severe drought.

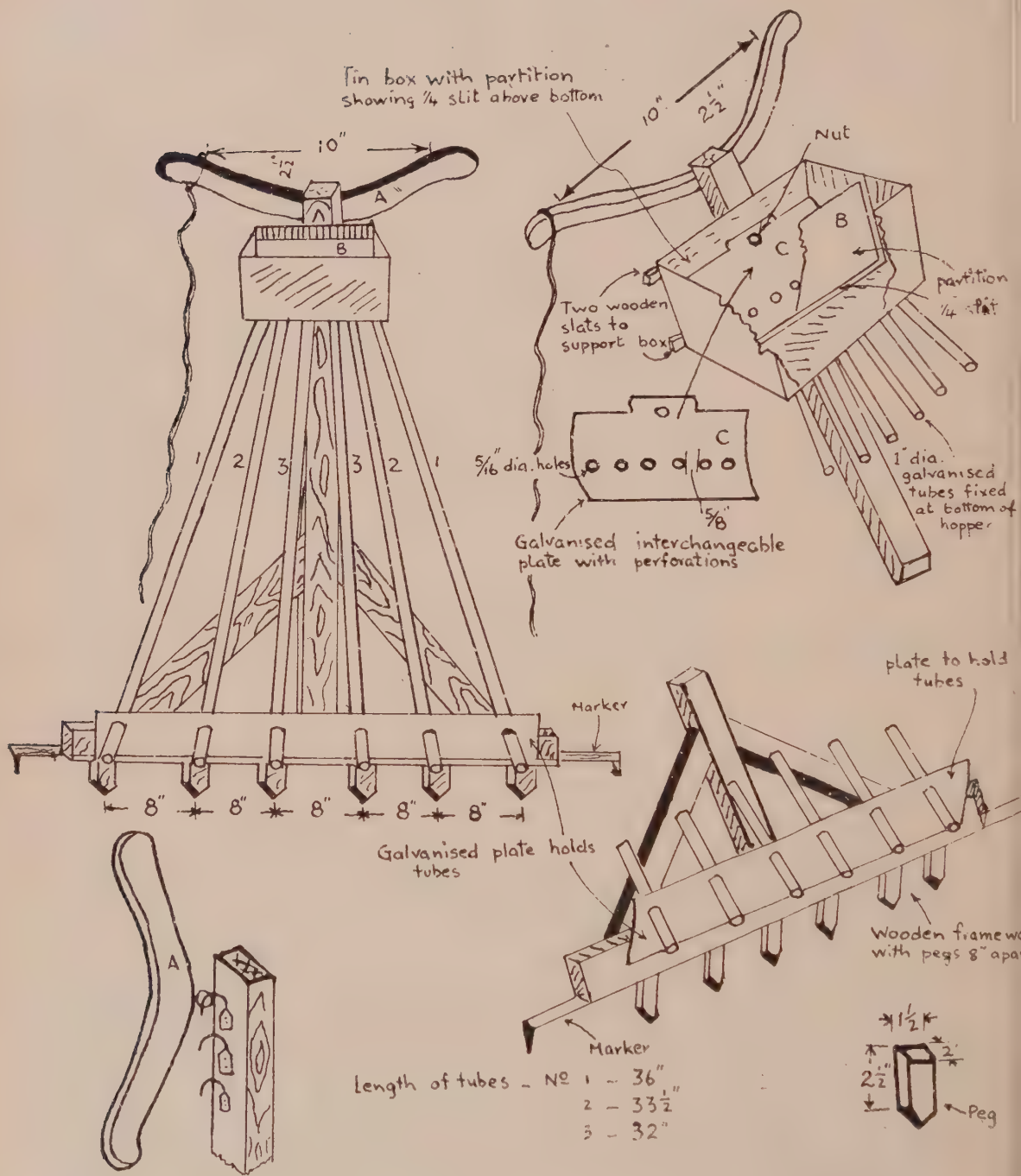


**Diagram of Paddy Seeder**

There was an incessant demand for weeders but unfortunately it was possible to supply only 75 and that too in April, 1956. A few cultivators who can afford the expense had however purchased one or two weeders for their use.

The trials were continued on the farms in *yala* 1956 with a view to testing other factors, chief among which was the reduction in cost on row sowing. In the normal process adopted so far, one man or boy was used to drag the marker followed by 3—4 women who dropped the germinated seed in the rows. This operation cost about Rs. 10 per acre and is relatively high compared to sowing paddy broadcast which involves only about 1/3 labour unit per acre per day. A combined seeder and marker (see diagram) was therefore designed to be worked by one labourer and this was tested out. With this inexpensive implement costing less than Rs. 12 and which can easily be turned out locally, 1½ acres could be row sown in one day by a woman, thereby reducing the cost of sowing to about Re. 1.25 per acre. With experience it should be possible for a woman to sow about 2 acres a day.

The seeder is similar to the Indian Seed Drill, but the tubes are of thin galvanized sheet. These are one inch in diameter and attached to a hopper which would take in about 4 measures of seed paddy. From the hopper, the seed passes on to a perforated disc which controls the seed rate. The perforated disc is interchangeable so as to adjust the seed rate. In the trials conducted, perforations of 5/16 inch were found to seed 34 measures of paddy per acre, while perforations slightly larger seeded 76 measures of paddy per acre. The varieties of paddy tested were *Sinnanayan* and *Rathkarayal*. Perforations of 0.25 inches would probably seed about 24 measures per acre of these varieties. This would be a desirable seed rate. The correct size of perforations would have to be determined for some of the larger or smaller seeded varieties. In seeding the operator fills the hopper and carries an additional quantity of seed paddy in a basket attached to his or her waist. The operator walks backwards, dragging the seeder which is strapped to the waist, and stirs the paddy to ensure even distribution. In the trials conducted, a woman was found to be able to seed ¼ acre in about 45 minutes. But making allowances for the tediousness of the job, one should be able to seed at least 1½ acres a day. With experience the acreage seeded per day can be raised to two. An improvement which is being borne in mind is a simple device to drop 4—6 seeds at regular intervals of 3—4 inches apart. But this will be done only after trials have been conducted on the relative merits of row sowing in continuous rows as against row sowing at a regular spacing of 3—4 inches in the rows.

In the light of the results obtained with the trials and the readiness with which cultivators have taken to this method of cultivation as compared to transplanting, the following recommendations are made :—

(*a*) Prepare the fields in the usual manner with 2 or 3 puddlings to ensure effective destruction of weeds.

(*b*) While this is being done, select good seed paddy, immerse it in salt water, taking only the seeds that sink in the saline solution, treat this with a fungicide and allow it to dry in the shade.

(*c*) Two and half days prior to sowing, soak the paddy in water for 24 hours and germinate it for 36 hours under weight.

(*d*) The day prior to sowing drain the water off the fields so that they are slightly wet the following morning.

(*e*) Broadcast half the fertilizer mixture on the evening of the day the water is being drained. At least 1 cwt. per acre should be applied.

(*f*) Row sow the germinated paddy with the combined marker-seeder using about one bushel of seed paddy per acre the following morning. One and a half acres can be done at a cost of a woman labour unit.

(*g*) Treat the fields thereafter as a broadcast plot.

(*h*) About 2 weeks to 18 days after row sowing, depending on the growth of the seedlings, intercultivate 3 inches deep between the rows with the weeder, thinning out plants in the rows if necessary. The weeding operation will cost less than 1½ labour units compared to 12—20 needed for the first hand-weeding.

(*i*) About 10-12 days after the first intercultivation, drain the water off, apply a quarter of the manure mixture between the rows of plants, adjust the intercultivator to a depth of 2 inches and work it. This second weeding will cost one woman unit of labour compared to about 8 women units for hand-weeding.

(*j*) About 10-12 days later repeat the process mentioned in (*i*) above. Apply the other quarter of the fertilizer and adjust the intercultivator to work to a depth of 1 inch.

(*k*) If preparatory tillage has been hurried and the weed growth is heavy as a result, a spraying of a 2-4-D preparation may be done to destroy "Kudametta" (*Fimbristylis miliacea*) within the rows of the paddy plant. The dosage is ¾ pints in 15 gallons of water. This may be necessary in rainfed areas.

(*l*) The spacing recommended for short-season varieties of paddy (3½ to 4 months) is 8 inches between rows. Three intercultivations can be given with the 6 in. weeder. If late-maturing varieties are used, a 10 in. spacing between the rows is recommended.

(*m*) An intercultivator costs about Rs. 25. It can be used with care for about 8—10 seasons. A combined seeder and marker can be turned out for about Rs. 12. The seeder can be used for several seasons.

(*n*) This method of cultivation is not recommended for the present in swampy fields.

**Discussion**

The potentialities of this method of cultivation are great and it is anticipated that within a short time the majority of paddy tracts generally, and in particular in the rainfed areas

Row-sowing germinated paddy with the Seeder

Intercultivating seedling paddy with the Japanese Rotary Weeder

Close-up of six weeks old row-sown crop, showing satisfactory tillering

A later stage of the row-sown crop, showing luxuriant growth

will be cultivated by this method for the following reasons :—(1) Time and energy need not be spent on raising nurseries. Time is a major factor in rainfed areas where preparatory tillage is usually restricted to two weeks. This period can now be entirely devoted to effecting a satisfactory preparatory tillage and ensuring effective weed destruction. The laying of nurseries and subsequent transplanting of the seedlings involves heavy expenditure ranging from Rs. 50 to Rs. 75 per acre, which the average cultivator in spite of all the inducements offered by way of easy credit facilities finds it extremely difficult to afford. Whilst transplanting, if properly done, may in several cases give increases greater than those obtained from row sown paddy, it has not interested the average cultivator in view of the high cost involved. (2) Nurseries have to be fenced for protection from cattle damage—thus involving additional expenditure. (3) There is a considerable saving in labour which is a serious problem during cultivation in the major paddy tracts. The result is that a hurried cultivation is done and very often half the extent is sown late because the same labour has to be used. Weeding then becomes a problem and quite a number of cultivators cannot afford to weed the paddy. (4) There is a saving in seed rate over the broadcast paddy. A bushel per acre would be sufficient. In parts of the Island, e.g., Udukinda, a seed rate of 4—5 bushels per acre is common. In other parts the seed rate is about 2½ bushels per acre. (5) There is very effective weed control in the growing crop and weeding costs have been reduced very appreciably. A woman can weed ¾ acre a day. About 24 labour units are thus saved during the three weeding operations. In rainfed areas or in areas where irrigation is restricted, if dry weather prevails at the time of weeding, no weeding can be done. But with the advent of favourable weather within a week to 10 days intercultivation of the row sown areas can be done with the weeder as the rows will be clearly visible in spite of the very heavy growth of Kudametta consequent on dry weather. In broadcast fields under similar conditions it will be very difficult to distinguish the paddy plant from the weed and if weeding has to be done, the cost would be prohibitive. Most cultivators therefore do not weed such fields. (6) In rainfed areas there is the constant risk of having to discard the nurseries and to resort to sowing the paddy broadcast later if the land is dry at the time of transplanting. If transplanting is done later when favourable weather intervenes, the seedlings are too old and will not tiller. This risk is eliminated in row sowing because the seed has to be soaked and germinated only 2½ days prior to sowing. If unfavourable weather prevails immediately after row sowing, the paddy field can again be lightly mudded and re-sown within 2½ days.

Judging by the results obtained under cultivators' conditions an increase of at least 10 bushels per acre can be expected by the adoption of this method of paddy cultivation. In other words if the present non-swampy broadcast areas are cultivated row sown, an increase of perhaps 8 or 9 million bushels of paddy plus a saving of about a million bushels of seed paddy can be effected annually. There is good reason to believe that this can be done, judging by the enthusiasm with which cultivators in the Southern Province are taking to it.

This method of cultivation has opened up other lines of investigation. For instance, in future selection work emphasis will have to be laid on varieties which tiller profusely and which do not lodge. Optimum spacing for each variety, optimum seed rate, optimum period of soaking and germination of seed paddy, optimum dosage of fertilizers, best method of row sowing, e.g., sown continuously or with 4—6 seeds at a spacing of 3—4 inches, &c., will have to be determined.

**Acknowledgments**

The author is grateful for the co-operation of all the officers in his Division and in particular to Messrs. W. Weeraratne, Farm Manager, Ambalantota, A. Morawakka, Farm Manager, Mapalana, B. D. Jayakoddi, Farm Manager, Labuduwa, for the trials conducted, and to Mr. W. Abayawana, Farm Manager, Bata-ata, for the construction of the seeder, once the design was given him.

REFERENCE

*Statistical Abstracts of Ceylon, 1955.*

# Broadling—A Promising New Technique in Paddy Cultivation

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DURING YALA 1953, the sample harvesting of transplanted and adjacent broadcast fields in the Kalutara District was conducted by the Statistician of the Department of Agriculture. He recorded a significant average increase in yield of 17 bushels per acre in the transplanted plots. But though " there was no significant depression of yield in any Range in the transplanted plots ", there was no significant difference in yield between transplanted and broadcast plots in some Ranges. A few observation plots were therefore laid out in *maha* 1954-55 in the same district to determine the influence of depth of transplanting on the growth and yield of paddy. Transplanting was done at depths of 1, 2 and 3 inches and, in addition, seedlings were broadcast on the surface (broadling). It was found that the broadled plots gave unexpectedly good yields.

This method of paddy cultivation (broadling), is suitable for any type of soil other than infertile sandy soils. It is, moreover, definitely advantageous on marshy soils as the plants do not sink when broadled as when transplanted.

As in the case of transplanting, only varieties over four months of age should be selected for broadling. *Murungakayan* and *Samba* varieties were noted to respond well to this technique. *Podiwi A.8* and *Ptb. 16* have also given good results.

Plants should be raised in nurseries as for transplanting, preferably on high land, as such nurseries produce strong and vigorous seedlings with a short but plentiful root system. Such plants when broadled put out new roots and shoots sooner than plants raised on mudland nurseries. Plants are uprooted at three weeks as for transplanting. The roots need not be thoroughly washed before broadling.

The field is prepared in the normal way as for broadcasting and the soil is well puddled. Water is drained out just before broadling and an average of two seedlings are broadcast at distances of 4-6 inches depending on the fertility of the soil.

Broadling should not be done when there is heavy rain as plants are dislodged. In case there is rain within the first three days of broadling the inflow of water from other *liyaddas* should be stopped. Even if the whole *liyadda* were to be flooded and plants were to float on the surface, they will quickly settle on the soil when the water is gradually drained off. With favourable

weather conditions plants have been observed to strike root within three days, during which period no irrigation water should be let into the fields. Thereafter, normal irrigation may be given, gradually increasing the depth of water.

Generally tillering commences about a week after broadling, although it has been observed to take place even earlier in some cases. In 2-3 per cent. of the seedlings, the mother plant dies leaving only the subsequent growth of tillers, whereas in the rest of the seedlings the mother plant raises itself erect and throws out tillers from its base at the same time. These tillers were noticed to have leaves broader and darker green in colour than the original mother plant and were more vigorous in appearance and growth. Up to 28 tillers have been counted on a single plant within one month of broadling.

Broadled plants respond well to judicious manuring and liberal applications of compost or cattle manure may be applied before and after broadling. As, in the early stages, the root system is very superficial, it is in a better position to utilize a larger portion of the manure in suspension in the upper layers of soil, unlike in transplanted seedlings. The following fertilizer mixture recommended by the Director of Agriculture was found to give good results :—

| | |
|---|---|
| Sulphate of Ammonia | .. 75 lb. |
| Concentrated Superphosphate | .. 75 lb. |
| Muriate of Potash | .. 25 lb. |
| Per acre | .. 175 lb. |

Half the quantity may be applied a few hours before broadling and the balance three weeks later after weeding. One month before flowering, a further application of 50 lb. of Sulphate of Ammonia as a top dressing gives beneficial results.

To facilitate cultural operations, broadling may be done at distances recommended for the Japanese method of transplanting, say 11 to 12 inches between rows and 4 inches within the row. This method is being tried out this season and the response so far is good, although it is too premature to express a definite opinion on yields as the crop is still in the growing stage.

During *yala* 1955, the writer had demonstrations of 8 broadled plots with adjacent transplanted fields—seven in Kalutara District and one in Colombo District. The average yields recorded at crop sample harvest were :

| | | |
|---|---|---|
| Broadled | .. 75.7 | bushels per acre. |
| Transplanted | .. 61.9 | " " |

At most locations the difference in yield exceeded 15 bushels in favour of the broadled plot.

The results of trials conducted by the writer during *maha* 1955-56 and sample harvested by the Agricultural Statistician are shown in Table 1.

The results of systematic trials conducted by the Botanist & Senior Agricultural Research Officer at Bombuwela and Panagoda Paddy Stations to compare broadling with transplanting at different depths are shown in Tables 2 and 3 respectively.

**TABLE 1**

| *Range* | *Location* | *Yield (bushels per acre)* | |
|---|---|---|---|
| | | *Broadled* | *Transplanted* |
| Horana | Kanawela | 69·4 | 69·4 |
| Panadura | Mawela | 54·4 | 49·2 |
| Kalutara | Maggona (St. Vincent's Home) | 65·0 | 38·8 |
| | Mean yield | 62·9 | 52·5 |

**TABLE 2—Bombuwela Paddy Station**

| | *Mas M 24 Yala 1955 Bushels/Acre* | *Murungakayan 303 Maha 1955–56 Bushels/Acre* |
|---|---|---|
| Surface planting (broadling) | 62·8 | 57·3 |
| Transplanting at 1″ depth | 60·5 | 46·1 |
| Transplanting at 2″ depth | 54·4 | 44·6 |
| Transplanting at 3″ depth | 49·2 | 35·8 |

**TABLE 3—Panagoda Paddy Station**

| | *Mas M 24 Yala 1955 Bushels/Acre* | *Murungakayan 303 Maha 1955–56 Bushels/Acre* |
|---|---|---|
| Surface planting (broadling) | 39·7 | 53·3 |
| Transplanting at 1″ depth | 47·4 | 53·3 |
| Transplanting at 2″ depth | 42·8 | 51·7 |
| Transplanting at 3″ depth | 41·6 | 50·4 |

A trial on broadling paddy also conducted by the D. A. O., Sabaragamuwa, during *maha* 1955-56 on one acre of paddy at Karapincha Agricultural Station, using *Siam 29,* gave a yield of over 53 bushels. The cost of production having been Rs. 304.40, the cost per bushel worked out at Rs. 6.35. The D. A. O. observed that " whereas it takes about 12 to 16 transplanters, it takes about 4 to 6 labourers to broadle an acre ".

It will thus be noted that the trials carried out under varying conditions showed that this system of paddy cultivation was definitely advantageous, particularly where transplanting is not possible as in marshy, ill-drained fields.

The general advantages of broadling over transplanting are as follows :—

1. Seed paddy requirements are lower.

2. It is possible to adopt this method on a wide range of soils.

3. The labour required is reduced by two-thirds. As such it is an economical method of paddy cultivation within the reach of the masses.

4. The rate of tillering is quicker and the number of tillers is also greater, thus increasing yields.

5. It requires neither specialized knowledge nor experience and even children can broadle.

Some of these broadled plots have been seen by distinguished experts in paddy from foreign countries, viz., Mr. D. Rhind, member of the Anglo-Australian Rice Commission and a former Director of Agriculture, Dr. K. Ramiah, Rice Expert, F. A. O., and Prof. S. Mitsui of the Faculty of Agriculture, Tokyo University, and Dr. T. Morinaga, Director of the National Institute of Agricultural Sciences, Japan, and they have all been impressed with the originality of the techniques and of its possibilities.

If broadling is adopted on a large scale, certain areas that now cannot be transplanted can be usefully converted into good yielding fields at little extra cost to the cultivator.

As the writer has retired from the Department of Agriculture, he has no facilities to carry out extensive trials. He, however, strongly recommends that further intensive trials be conducted by the Department of Agriculture over a continuous period of time on this technique, which he is confident should prove of distinct benefit to paddy production.

**Acknowledgments**

I have to express my indebtedness to a number of gentlemen who have collaborated with me in testing out this technique on their paddy fields in the Kalutara and Colombo Districts, and to the Director of Agriculture, Dr. A. W. R. Joachim, and Dr. M. F. Chandraratne, Assistant Director of Agriculture (Technical), and others in the Department for their advice and encouragement in this work.

# Control of Seedling Blight of Rice caused by *Fusarium moniliforme* Sheld (*Gibberella fujikuroi* (Saw) Wr.)

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*Received 8.6.56.*

## Introduction

Poor germinability of the seed and post-emergence seedling diseases of rice are caused by several seed and soil borne fungi. Among these *Helminthosporium oryzae*. Breda de Haan, *Piricularia oryzae* Cav. and *Fusarium moniliforme* Sheld. (*Gibberella fujikuroi* (Saw) Wr.) are to a large extent seed transmitted and are of economic importance in Ceylon. Primary infection of seedlings by these fungi may be prevented by seed disinfection with suitable materials. A great variety of organo-mercury formulations, copper compounds and fungicides containing thiram have been tested by several workers against seed-borne organisms of cereals and their relative effectiveness in controlling seedling diseases ascertained. In the present investigation a number of more recent proprietary seed dressings have been tested against *F. monoliforme* (*G. fujikuroi*) and the phytotoxic properties of these materials and their effect on root and shoot growth ascertained.

## Historical

A considerable measure of control of the primary infection of *F. moniliforme* (*G. fujikuroi*) has been obtained by Ito and Kimura (1931) by disinfection of the seed with formalin. Subsequently Ito (1932) reported that the conidial death point of *F. moniliforme* (*G. fujikuroi*) subjected to mercuric chloride and formalin was 0.1 per cent. and 0.7 per cent. respectively. The use of formalin, however, requires great care as a slight increase in the concentration may adversely affect germination of the seed. Thomas (1933) tested a number of wet and dry seed disinfectants and concluded that most of the treatments reduced primary infection to a considerable extent. He obtained promising control of the disease with the commercial seed dressings Uspulun, Ceresan and Tillantin, Semesan and Granosan. Copper sulphate was inferior to these preparations and inhibited germination of the seed. Sundararaman (1936) obtained better control of the disease with the organo mercury product Ceresan than with copper sulphate or Bordeaux mixture. Peiris (1951) reported that seed dressing with Agrosan GN at 2 ounces per bushel effectively controlled the disease.

## Materials and Methods

The following seed dressings were tested :—

| *Seed Dressing* | *Active Ingredient* |
|---|---|
| Agrosan GN .. | Mixture of phenyl mercury acetate and ethyl mercury chloride |
| Ceresan .. | Methoxethyl mercury chloride |
| Tillex .. | Ethyle mercury chloride |
| Fernasan A .. | bis (dimethylthiocarbomyl) disulphide |
| Yellow Cuprocide | Cuprous oxide |
| Perenox .. | Cuprous oxide |
| Cerenox .. | Systemic fungicide, active ingredient unknown |

The seed of the variety *Heenati 309* which is susceptible to attack by *Fusarium moniliforme* (*Gibberella fujikuroi*) was inoculated with a heavy spore suspension of the fungus and air dried for a week at the room temperature. Each fungicide was applied to the seed in a 250 ml. Erlenmeyer flask ; uniform application of the material was ensured by shaking the flask for 2 minutes. The liquid seed disinfectant was applied by the immersion process ; the seed was immersed in the disinfectant for 30 minutes, air dried and stored in conical flasks. The effectiveness of seed protectants was assessed by the following methods :—

**1 Laboratory Method.** This is based on the Ulster method of testing seeds for the presence of seed-borne organisms described by Muskett and Malone (1941). In this method untreated seed and those treated with fungicides were plated on 2 per cent. dextrose agar at the rate of 100 seeds per treatment and per cent. colonies of *F. moniliforme* (*G. fujikuroi*) produced estimated. The method is especially useful for rapid laboratory evaluation and elimination of unpromising seed protectants. However, conditions obtained in vitro tests were considered too severe for final evaluation and the materials were tested further by the pot culture method.

**2 Pot Culture Method.** Unsterile clay soil was placed in pots 5½ inches diameter ; the moisture content of the soil was adjusted and maintained at 100 per cent. saturation. Untreated seed and those treated with different protectants was germinated and shown at the rate of twenty-five seedlings per pot. Each treatment was replicated three times and the pots were arranged on a greenhouse bench. The experiment was continued for a period of two weeks ; infected seedlings were periodically removed to prevent secondary infection. The results are given in Table I and II. The results of the pot culture experiment were analysed statistically after transforming the data to the inverse sine scale. The mean equivalent angles thus obtained are shown in the last column of Table I. The mean percentage seedlings diseased and the mean equivalent angles of the protectants irrespective of concentration used is shown in Table II. The analysis of variance of the transformed data is shown at the bottom of Table II.

**TABLE I—Effect of Seed Protectants on Emergence and Control of Seedling Blight of Rice caused by *F. moniliforme* (*G. fujikuroi*)**

| *Treatment* | *Dosage* | *Per Cent. Emergence* | *Per Cent. Colonies on Agar* | *Mean Per Cent. Seedlings diseased* | *Mean equivalent Angle of Seedlings diseased* |
|---|---|---|---|---|---|
| Agrosan GN | 2 oz./cwt. | 97 | 0 | 2·67 | 5·47 |
| | 4 oz./cwt. | 96 | 0 | 1·33 | 3·83 |
| | 6 oz./cwt. | 69 | 0 | 0 | 0 |
| Ceresan Dry | 2 oz./cwt. | 98 | 0 | 0 | 0 |
| | 4 oz./cwt. | 76 | 0 | 0 | 0 |
| | 6 oz./cwt. | 66 | 0 | 0 | 0 |
| Ceresan Wet | ½ lb./100 gals. | 98 | 4 | 1·33 | 3·83 |
| | 1 lb./100 gals. | 99 | 0 | 1·33 | 3·83 |
| | 1½ lb./100 gals. | 99 | 0 | 1·33 | 3·83 |
| Tillex Dry | 2 oz./cwt. | 99 | 0 | 1·33 | 3·83 |
| | 4 oz./cwt. | 98 | 0 | 1·33 | 3·83 |
| | 6 oz./cwt. | 92 | 0 | 0 | 0 |
| Tillex Wet | 1¼ fl. oz./13 gal. | 99 | 2 | 2·67 | 5·47 |
| | 2½ fl. oz./13 gal. | 99 | 0 | 0 | 0 |
| | 3¾ fl. oz./13 gal. | 98 | 0 | 0 | 0 |
| Fernasan A | 2 oz./cwt. | 95 | 25 | 5·33 | 10·93 |
| | 4 oz./cwt. | 98 | 16 | 2·67 | 7·67 |
| | 6 oz./cwt. | 92 | 8 | 1·33 | 3·83 |
| Perenox | 2 oz./10 gal. | 97 | 44 | 18·67 | 25·40 |
| | 4 oz./10 gal. | 98 | 23 | 13·33 | 21·40 |
| | 6 oz./10 gal. | 97 | 14 | 8·00 | 15·53 |
| Yellow Cuprocide | 2 oz./cwt. | 82 | 42 | 18·67 | 25·40 |
| | 4 oz./cwt. | 71 | 38 | 10·67 | 18·80 |
| | 6 oz./cwt. | 88 | 31 | 6·67 | 14·77 |
| Cerenox | 150 gms./100 kgs. | 100 | 76 | 41·33 | 39·90 |
| | 300 gms./100 kgs. | 96 | 76 | 37·33 | 37·60 |
| | 450 gms./100 kgs. | 98 | 72 | 37·33 | 37·57 |
| Control | | 99 | 87 | 58·67 | 50·10 |
| Significant difference at P = ·05 | | | | | 8·96 |

**TABLE II—Effect of Seed Protectants on Control of Seedling Blight of Rice caused by *F. moniliforme* (*G. fujikuroi*)**

| *Fungicide* | *Mean Per Cent. Seedlings diseased* | *Mean equivalent Angle* |
|---|---|---|
| Ceresan Dry | 0 | 0 |
| Tillex Wet | 0·89 | 1·82 |
| Tillex Dry | 0·89 | 2·25 |
| Agrosan GN | 1·33 | 3·10 |
| Ceresan Wet | 1·33 | 3·83 |
| Fernasan A | 3·11 | 7·48 |
| Yellow Cuprocide | 12·00 | 19·60 |
| Perenox | 13·33 | 20·78 |
| Cerenox | 38·66 | 38·36 |
| Control | 58·67 | 50·10 |
| Significant difference between control and seed protectants at P = ·05 | — | 7·32 |
| Significant difference between seed protectants at P = ·05 | — | 5·24 |

**Analysis of Variance of Percentage Seedlings Diseased**

DATA TRANSFORMED TO INVERSE SINE SCALE, $\Theta = \sin^{-1}\sqrt{P}$

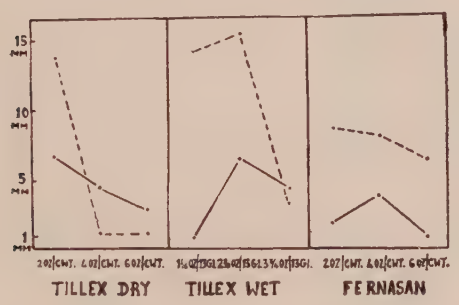
| | Degrees of freedom | Sums of squares | Mean Square | F |
|---|---|---|---|---|
| Treatments .. .. | 27 | 16894·11 | 6257·08 | 207·48 |
| Within treatments .. .. | 56 | 1688·77 | 30·157 | — |
| Total .. | 83 | 18582·89 | | |

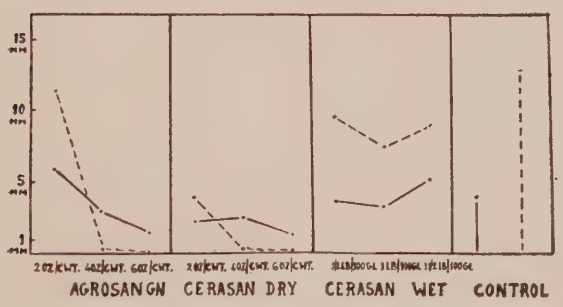
At all three dosages the organomercury formulations gave good control of seedling blight. At the low dosage tested, that is, 2 ounces of the material per cwt. of seed, the performance of Ceresan Dry was superior to other organomercury dry seed dressings. The differences obtained are however not statisticallly significant and it would be difficult to evaluate the relative efficacy of the different organomercury formulations. The performance of Fernasan A was promising both in vitro and in the pot experiment but was less effective than the organomercury protectants; the effectiveness of this material increased progressively with the increasing quantity used for disinfection. Although Perenox, Yellow Cuprocide and Cerenox diminished fungus growth on agar and decreased seedling blight considerably they were less efficient than either the organomercury formulations or Fernasan A.

**Emergence.** A critical factor in chemical seed disinfection is dosage; a slight increase in the quantity of the material may depress emergence and subsequent growth of seedlings. At the high concentration used the organomercury dry treatments Agrosan GN, Ceresan and to some extent Tillex inhibited germination of the seed; wet treatment with Ceresan and Tillex however was not inhibitory at all three concentrations. Of the copper compounds Yellow Cuprocide gave less consistent emergence; Perenox did not inhibit germination but delayed seedling emergence. Fernasan A at the high concentration inhibited germination slightly whereas Cerenox was not inhibitory at all three dosages tested.

**Phytotoxicity.** The relative lengths of roots and shoots as influenced by the different treatments are shown in Fig. I, the measurement being taken when seedlings were 10 days old. Certain seed protectants were phytotoxic and had a considerable influence on root and shoot elongation especially during the early stages of emergence and growth. At high dosages tested the organomercury dry treatments depressed root and shoot growth; Agrosan GN, Ceresan and Tillex progressively decreased root and shoot elongation with the increase in concentration of the seed protectant. All three protectants produced stout and stunted shoots when treated at 6 ounces per cwt. of seed. As opposed to dry, the organomercury wet treatments produced better root and shoot growth; Ceresan Wet increased shoot elongation at the concentration of 1½ lb. in 100 gallons of water but had a slight inhibitory effect on root development. Tillex at a concentration of 2½ fluid ounces in 100 gallons of water increased both root and shoot elongation.

15
10
5
1
2 oz/10GL 4 oz/10GL 6 oz/10GL
2 oz/CWT. 4 oz/CWT. 6 oz/CWT.
150 G/100K, 300G/100K, 450G/100K,
PERENOX
YELLOW CUPROCIDE
CERENOX


15
10
5
1
2 oz/CWT. 4 oz/CWT. 6 oz/CWT.
1½ oz/15GL 2½ oz/15GL 3½ oz/15GL.
2 oz/CWT. 4 oz/CWT. 6 oz/CWT.
TILLEX DRY
TILLEX WET
FERNASAN


15
10
5
1
2 oz/CWT. 4 oz/CWT. 6 oz/CWT.
2 oz/CWT. 4 oz/CWT. 6 oz/CWT.
AGROSAN GN
CERASAN DRY
CERASAN WET
CONTROL

Although Fernasan A had no beneficial effect on seedling growth it did not radically depress root and shoot elongation.

Both Perenox and Yellow Cuprocide delayed emergence and root growth. Perenox was more beneficial than Yellow Cuprocide to shoot elongation.

Cerenox increased shoot elongation at low dosages but had little effect on root growth.

## Discussion

In this investigation a variety of the more recent seed protectants have been subjected to laboratory and pot culture tests and the ability of these formulations to control the seedling blight disease of rice caused by *F. moniliforme* (*G. fujikuroi*) was assessed. A high degree of correlation exists between the results obtained by the two methods. A correlation coefficient of 0.9607 which is significant even at P = .001 has been obtained. The equation connecting per cent. colonies on agar (A) and mean per cent. seedlings diseased (S) is S = 0.53 A—0.34. The laboratory method could therefore be used for rapid evaluations and to eliminate unpromising materials against *F. moniliforme* (*G. fujikuroi*).

Of the protectants tested the only satisfactory ones were the organomercury formulations. The differences between the various organomercury formulations are not statistically significant; the tests employed are not sufficiently sensitive to establish differences between these compounds. Cuprous oxide preparations would be unsuitable for general use as a seed disinfectant on rice. The copper compounds were less effective than the organomercury formulations and caused a noticeable growth depression of the seedlings. Fernasan A has given promising control of the *Fusarium* disease but its general use as a rice seed disinfectant has to be further investigated. It has however the advantage that it has a comparatively lower mammalian toxicity than the organomercurials.

Use of the correct dosage of the protectant is an important factor in rice seed disinfection. This applies in particular to the poisonous organo mercury compounds where an increase in dosage of the protectant may inhibit emergence and cause growth depression of roots and shoots.

It may therefore be tentatively suggested that a good seed protectant should not allow more than 0.5 per cent. of the disease to escape control in a pot culture test. Although such a requirement is severe the results obtained show that more than one proprietary protectant satisfied these conditions.

## Summary

Several seed protectants have been subjected to laboratory and pot culture tests and the efficacy of these compounds to control the seedling blight disease of rice caused by *Fusarium moniliforme* (*Gibberella fujikuroi*) has been evaluated.

A high degree of correlation has been found to exist between the laboratory and pot culture methods. A correlation coefficient of 0.9607 which is significant even at P = .001 has been obtained. The results of the pot culture method were transformed to the inverse sine scale and statistically analysed. The performance

of organomercury and thiram formulations was distinctly superior to other materials tested. Statistically significant differences were however not established between the different organomercury formulations.

An important factor in seed disinfection is the dosage of the protectant—slight excess of the material could depress emergence and have phytotoxic effects on root and shoot growth.

**Acknowledgements**

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# The Role of the Agriculturist in the Development of Fish Production

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Ceylon with a population of about 8,000,000 had to import fish to the value of Rs. 68 million in 1955. This represents the value of about 85 million lb. of fish. The total local production of fish may be roughly assessed at 90 million lb. This is harvested by about 60,000 fishermen giving an average production of 1,500 lb. per head per year. For comparison with this productivity, we have fairly well developed countries such as Denmark where the average production is about 33,000 lb. per head per year, and the highly specialized purse seine fishery of the West Coast of Canada which yields a production of over 150,000 lb. per head per year.

The bulk of Ceylon's fish production now comes from the sea. Nevertheless, there are about 140,000 acres of inland fresh waters and about 300,000 acres of brackish and salt water lagoons which are today producing comparatively little fish. Similar natural waters in Indonesia, where the climate and conditions are very much like those found in this country, give an yield of about 700 lb. of fish per acre per annum. If the fresh waters in Ceylon were to be stocked with suitable food fishes and harvested regularly, there is no reason why they should not yield an average of 500 lb. per acre per annum. This would give Ceylon an additional 70 million lb. of fish per year. This estimate does not take into account the possible production from brackish and salt water lagoons.

**The Gouramy**. A good index of the prospects of increasing the production of fish from our fresh waters can be found in the accidental introduction of the Gouramy into Ceylon waters. This fresh water fish is extensively cultivated and highly esteemed as a food fish by the peasants of Java, from where a few specimens were introduced by the late Mr. G. M. Fowler, a keen fisherman, about the year 1900, but none of these fishes survived. In 1909, a further supply was brought from Java to Colombo by the late Mr. Kelway Bamber. These were distributed among the dams at Mahavilla estate in Ulapane, Drayton in Kotagala, the Galle reservoir at Hiyare, and an oranamental pond below the Thwaites Memorial building in the Royal Botanical Gardens, Peradeniya. In subsequent years there were a number of floods at Peradeniya, when the level of the flood waters in the Mahaveli river rose so high that this pond was submerged. In 1935, on receipt of reports of a new fish which was appearing in increasing numbers in the catches of the fishermen operating in the " villus " or flood lakes at Mannampitiya, about 100 miles lower down the river, a few specimens were obtained. They were found to be Gouramy. The Gouramy has now extended its range, and is found

to be very numerous in the catches in the lower reaches of the Mahaveli. A fisherman at Allai near the Kilivetti ferry told the author in 1952 that, whereas in past years Gouramy used to represent about 5 per cent. of the catches, the proportion has gradually increased and they are now getting as much as 90 per cent. Gouramy. The rest of the catch consists largely of the murral or snake head, locally known as 'lula'. The secret of its rapid establishment in our waters lies in the fact that the Gouramy is a vegetation feeder ; in other words, the greater part of its normal diet consists of vegetable matter. In this respect, the Gouramy encounters very little competition from other fishes because our natural waters show a preponderance of predatory fishes, and many tons of aquatic plant life go to waste every year in our inland waters. The Gouramy is now converting these virtually useless plants into valuable animal protein food for man.

Since that time, supplies of Gouramy have been distributed by the Fisheries Department into an increasing number of the larger perennial tanks, into estate dams, private ponds, and the principal rivers in the Island ; great quantities are now harvested from Parakrama Samudra, Giritale, Minneriya, Amparai, Nachchaduwa and Nuwara Wewa. Using this experience as a guide, steps were taken to introduce other food fishes of good table quality, particularly of the vegetation feeding types.

**The Tilapia.** When the author was in Malaya in 1948, he came across a vegetation feeding fish called *Tilapia mossambica,* which was very well spoken of as a food fish in Malaya, and which had proved to be a valuable means of ridding inland waters of the larvae of malaria-bearing mosquitoes. Experiments conducted by the health authorities at Taiping had proved beyond doubt that Tilapia had completely eradicated mosquito larvae from the Taiping lakes within a few months of their introduction. Similar results have been recorded in Bengal. It was found that the fish would breed freely from about 3 months of age and that it would grow into a reasonable sized fish within a year. This fish had solved the fish farmer's problem of fry supply in the Indonesian fish farms during the war, when the normal supplies from China were cut off. After discussion with the F. A. O. authorities, and careful observation of the feeding habits of the fish, 750 specimens of *Tilapia mossambica* were imported by air on July 17, 1951, since when this fish has established itself firmly in our waters. The fish is a "mouth breeder" and the female carries its young in its mouth until they are able to fend for themselves. Examination of the stomach contents of a number of specimens has revealed that the fish will feed exclusively on vegetation where this is abundant.

When the "lewayas" (brackish water lakes) of Hambantota dried up completely in 1952, they were subsequently stocked with Tilapia after the rains, and this action has given rise to a fishery which has been of considerable importance to the residents of Hambantota since 1954. Production of Tilapia from the Karagan-lewaya which was about 5,000 lb. in January 1954 was 155,000 lb. in July, and 168,000 lb. in August 1954. Fish traders have been attracted, and there is a daily transport of fish by cycle and lorry to districts as

far away as Haputale. Alas! Karagan lewaya dried up completely in the drought of 1956. Tilapia is appearing in increasing quantities in the markets in many other rural areas into which it has been introduced, and it is captured both from inland waters and in lagoons right round the coast. It is highly esteemed as a food fish and has a ready sale. The largest specimens so far recorded were about 15 in. in length and weighed over 2 lb. Lake Tempe, in Celebes, might be cited as an example of what can be achieved. In 1935 the fish production was virtually nil, and a variety of food fishes was introduced into the lake. In 1948, 13 years later, the production was 25 million pounds of fish. But these foregoing remarks refer to results which might be obtained without any effort at intensive cultivation. With a little effort, an even more abundant production should be possible.

**De-silting "Tanks".** Nearly all the inland waters in the Island consist of irrigation reservoirs or " tanks ". Some of these contain water throughout the year. A great many of them dry up during the drought. All these tanks contain water which is greenish in appearance. This greenish colour is due to a large quantity of living matter, both plant and animal, which is held in suspension in the water. This is known as plankton. There are virtually no fish of appreciable table quality, in these waters, which feed on plankton. Therefore a great deal of food matter which might be converted into fish flesh in our inland waters is now going to waste every year. These same waters also contain an abundant growth of the larger water plants. Each year, when these waters dry up, this vegetation decays on the surface, adding to the layer of silt at the bottom of the tank, and from year to year these tanks are gradually silting up. The progressive effect of this silting can be seen in the great majority of the smaller village tanks. Their capacity to hold water is being gradually diminished. They fill up to spill level within the first few days of the normal North-East Monsoon rains, and overflow for a greater portion of the rainy season. Within the first three months of the dry weather setting in, these tanks run dry. Now this same deposit which silts up the tank bed contains valuable organic matter which could be used with benefit for manuring arable land. This organic matter eventually dies and decays, and it derives the oxygen necessary for its decomposition from the water, releasing acids into the water, both conditions being detrimental to the growth of fish. The removal of this silt from the tank bed for the purpose of manuring the fields will not only deepen and desilt the tank, thereby increasing its capacity to hold water, but also provide better conditions for the growth of fish in the tank when it fills up again. If the peasant can be made to see that this caked, peaty substance, which he can dig up from the tank bed when it is drying up, will improve his crops and his paddy fields, and if he can be encouraged to remove, progressively, this silt from the tank and apply it on his fields, he will gradually increase the capacity of his tank and may perhaps live to see the day when the tank does not go dry even in the severest drought. What a change such a condition can bring about in the drought ridden zone!

This is where the agriculturist can derive great benefit from the adoption of a water conservation and water utilization programme on his land. Soil erosion

can be effectively checked by the construction of dams across gullies and ravines. This will not only check erosion, but hold up valuable water for the watering of stock and the rearing of fish. An acre of water, carefully stocked and managed can give 5,000 lb. of fish each year. In Indonesia they have an average of 1,000 lb., and in the Belgian Congo 2,000 lb. per acre per year, with maximum of 8,000 and 9,000 lb. per acre per year. The waste products of the land serve as food for the fish or fertilizer for the water, and the waste produce of the pond, that is, the silt dredged up from the bottom of the pond, serves as manure on the land. By this means, waste is eliminated, and the farmer produces his requirements of protein from the water. It will make a very interesting study if a comparison were to be made of the production from farm land with the production from a fish pond, in terms of the annual yield of protein food per acre from each.

**Fish Culture in Paddy Fields.** Much has been said recently about the prospects of rearing fish in paddy fields. This is best done in areas where water is abundantly available. This practice is widely prevalent in the wetter areas of Malaya and the East Indies. In Indonesia with a rice crop in which water can be impounded for from 40 to 60 days, yields of from 30 to 50 lb. of fish per acre have been recorded. In Japanese rice fields the yield is about 150 lb. per acre, but, when food is added, yields of 2,000 lb. per acre have been obtained. In Malaya, the yield is about 125 lb. per acre. In Tanganyika, yields of 1,000 lb. of rice and 100 lb. of fish per acre are obtained. The Russians have reported a 7 per cent. increase in the rice crop when fish are grown under it. In China, a 10 per cent. increase in the rice crop has been reported.

Little modification of the fields is required for fish raising. The bunds of the paddy field are raised and strengthened with the earth obtained in constructing a trench about a yard wide, a couple of feet deep, and about 30 feet long along the lower side of each paddy flat, so that if the water level in the field were to go down when the farmer is away, the fish will still have the trench into which they can retreat, until the farmer comes back and restores the water level in his fields. A sump pond of about 10 ft. by 10 ft. or less is made in the lowest field in the block. As soon as a depth of four to six inches of water can be maintained under the paddy plants, that is about 2 weeks after transplanting, small-sized fish are introduced at the rate of about 1,000 per acre. The water inlets and outlets in each block of fields are screened to prevent the escape of the fish. The fish feed among the paddy plants, eating off the algae which compete with the paddy plant for the nutriment in the soil and eating the larvae of insect pests such as the paddy stem borer, and their droppings provide a readily soluble organic fertiliser which benefits the crop. When the field is dried for the harvest, the fish are gathered into the sump pond by progressive draining of the flats and are captured from there.

The advantages in the introduction of plankton feeding food fishes into inland waters are obvious. They will convert naturally available organic matter, which is now going waste, into fish flesh which will supply the deficiency of protein in peasant diets. They will make this protein available in the less frequented and more backward districts where the channels of trade seldom

penetrate and where protein food is almost unavailable. What the farmer cannot use immediately in the fresh form he can salt and dry in the sun and keep for his own use during the rest of the year. With the increased production of fish from inland waters there will be a greater self-sufficiency in fish, and the large sums of money which are now being spent on the import of fish will be progressively reduced.

The practice of rearing fish in paddy fields does not require any elaborate or expensive preparation. It is carried out successfully by peasants in other parts of South-East Asia who are no more erudite than the peasants in this country, and the fact that this practice has been carried on for so many years in these areas can have only one explanation, namely, that the farmer is able to get a higher income from his labours when he grows fish under his paddy crops than when he does not. The hope of gain sweetens the labour involved.

**Summary.** It is necessary that every landowner should realize the vast potentialities which exist for improving the yield of his land through a policy of proper water conservation and water utilization. The water holding capacity of the land must be developed by a system which will at once protect his land from eroding run-off, and provide water for irrigation and livestock needs. Every body of water, whether behind a dam or only a few inches deep in a paddy field, can and should be utilized to produce protein food through judicious stocking with fish of table quality. The best farmers in other countries with a climate similar to that of Ceylon have realized and made full use of the complementary nature of land farming and water utilization, and there is no reason why their example should not be followed profitably in this country.

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# A Brief Survey of Agricultural Conditions in the Eastern Division

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**General.** The Eastern Division consists of the Revenue District of Batticaloa. It is bounded on the East by the sea, on the West by portions of Badulla and Polonnaruwa Districts, on the North by Verugal Aru, a branch of the Mahaweli Ganga, and on the South by Kumbukkan Oya. Five other rivers arising in the Badulla District run through this area eastwards into the sea. These rivers supply water to the numerous tanks which irrigate paddy, the main crop of the District. The total land area is 1,729,000 acres of which only 185,000 acres are under cultivation. The total population in 1953 was 270,722 mainly concentrated along the coastal belt. There is one main coastal road with branches going to Polonnaruwa, Badulla, Inginiyagala and Moneragala. There are few good roads in the mainland. Communications are made more difficult by a 30 miles long lagoon which separates the thickly inhabited coastal belt from the mainland where the paddy areas are situated. Transport across the lagoon is by means of boats and ferries and is very unsatisfactory. There are only 40 miles of Railway covering less than 1/10 of the area. The District is divided into 9 Divisional Revenue Officers' Divisions The Development area of the Gal Oya Scheme falls within the boundaries of the District.

**Weather.** The District falls within the Dry Lowland Zone of the Island. The major portion of the District is below 100 ft. in elevation with a small section going up to 300 ft. The average temperature for the year is about 81° F. December and January are fairly cold with average temperatures of 77° F. June and July are very warm with an average of 85° F. During these months a warm dry wind called "Kachchan" blows over the District. This is really the South-West Monsoon deprived of its moisture in its ascent over the Central Hills and heated by compression in its descent on the leeward side. The average monthly rainfall in inches in four stations are given in Table 1.

**Table I—Average Monthly Rainfall**

| | *Kalkudah* | *Batticaloa* | *Amparai* | *Panama* |
|---|---|---|---|---|
| January | 13·8 in. | 12·9 in. | 14·1 in. | 12·1 in. |
| February | 4·3 | 4·2 | 4·9 | 4·6 |
| March | 3·7 | 3·5 | 3·8 | 4·2 |
| April | 2·3 | 2·3 | 3·5 | 3·1 |
| May | 2·8 | 1·8 | 3·5 | 2·0 |
| June | 0·4 | 0·9 | 1·7 | 0·0 |
| July | 1·8 | 1·0 | 1·8 | 0·8 |
| August | 2·4 | 2·0 | 2·9 | 1·6 |
| September | 2·8 | 2·4 | 3·6 | 1·9 |
| October | 8·2 | 7·2 | 7·1 | 5·0 |
| November | 11·7 | 13·9 | 11·0 | 9·7 |
| December | 18·6 | 17·0 | 14·4 | 10·3 |
| Total | 72·8 | 69·1 | 72·3 | 55·3 |

The rainfall is fairly uniform throughout the District at about 70 inches except in the extreme south where it goes down to 55 inches. Small sections in the interior get a little over 75 inches. It will be seen from the above figures that the North-East Monsoon rains bring 70 per cent. of the rainfall during the months of October to January. The other 8 months get only 30 per cent. Very little or no rain falls during June and July. This dry period in combination with the dry wind "Kachchan" is harmful to all crops and stock. Annual crops cannot be grown during this season except under irrigation. The North-East Monsoon rains, however, are very favourable for paddy cultivation. There may have been occasional droughts during this season reducing paddy yields but very rarely have there been complete failures of crops as are common in other parts of the dry zone of the Island.

**Soils.** There are 3 main types of soils in the District :—

(*a*) The Coastal belt contains the sandy soils derived from Pleistocene deposits.

(*b*) A middle area of non-lateritic grey-brown sandy loams.

(*c*) Lateritic or non-lateritic reddish brown or grey-brown loams in the interior.

The sandy soils along the coast constitute the coconut soils and the low lying sections and tracts with irrigation facilities are cultivated with paddy. The reddish brown or grey-brown loams are suitable for a variety of crops but the bad distribution of rainfall limits the choice of crops.

The soils being derived from acidic types of rocks are deficient in lime and magnesia and potash content should normally have been high. But the intense rainfall experienced from October to January and the open texture of the soil are responsible for leaching out much potash and thus the soils are deficient in this constituent also. The organic matter content of these soils is very low and is the most important requirement not only for the supply of plant nutrients including trace elements but also for moisture conservation. The phosphoric acid supply is variable but is often low. Thus the fertility of the soil is generally far below the average for the Island. Regular applications of cattle manure, compost or green manure are necessary to obtain satisfactory yields. The application of nitrogen in the form of fertilisers has resulted in a marked increase in yields. Phosphoric acid is best applied as Superphosphate to obtain quick results and potash as Sulphate of Potash because sulphur is also necessary for these soils.

**Paddy.** This is the most important crop of the District covering 134,700 acres out of the 185,000 acres of cultivated area. Although the climate is favourable for paddy cultivation, yields are poor owing to the low fertility of the soil. Crop cutting experiments have given the following yields :—

| *Maha* | *Bushels Per Acre* | *Yala* | *Bushels Per Acre* |
|---|---|---|---|
| 1951–52 | .. 29·48 | 1952 | .. 36·2 |
| 1952–53 | .. 24·85 | 1953 | .. 35·38 |
| 1953–54 | .. 28·10 | 1954 | .. 29·65 |
| 1954–55 | .. 29·52 | 1955 | .. 31·27 |

**Holdings.** Compared to the rest of the Island the average size of paddy holding

in the District is very large. There are 21,000 holdings covering 134,700 acres, i.e., 6.4 acres per holding whereas the average for the Island is only 1.2 acres The high average is due to the large number of holdings over 10 acres in extent. Several landlords own more than 200 acres each. The 1946 census gave the following figures for the District :—

| *Size of Holding* | *Number* | *Acreage* |
|---|---|---|
| Less than ½ acre | 160 | 39 |
| ½–1 acre | 230 | 134 |
| 1–2 acres | 1,400 | 1,741 |
| 2—5 acres | 6,417 | 19,942 |
| 5—10 acres | 5,840 | 35,800 |
| More than 10 acres | 3,244 | 61,512 |

The number of holdings of more than 10 acres represents 40 per cent. of the all-Island figures and exceeds that of any other District in the Island. The large size of holdings facilitates mechanisation but does not help adoption of intensive methods of cultivation.

**Tenures**. About 4,500 holdings are leased out for cultivation. There are 3 main types of tenure.

(*a*) *Cultivation on "Rent" Basis.* Here the cultivator pays a definite rent in the form of paddy and the landlord also termed *Podiar* does not take any part in the cultivation. The rent may be paid at the commencement of the season or an increased rent may be paid after harvest. In Batticaloa South where this system is most prevalent the usual rent is 7½ bushels of paddy per acre per season. In addition the cultivator may give various types of presents to the landlord.

(*b*) *Cultivation on "Customary" Basis.* Here the landlord bears all the cultivation expenses and gives the cultivator 3 bushels of paddy per month during the cultivation period of 5 months for his food. After harvest the cultivator gets 1/10 of the yield and the sweepings from the threshing floor.

(*c*) *Cultivation on "Loan" Basis.* Here the landlord advances to the cultivator the seed paddy and paddy for his consumption during the cultivation period. The landlord also supplies cattle for ploughing and the hire for the cattle is computed in paddy. These loans are first recovered from the harvest with 50 per cent. interest. Harvesting, stacking and threshing expenses are met by the landlord and not regarded as loans. A ground rent of 2½ bushels per acre is also due to the landlord. After deducting all the above items, the balance harvest is divided between the landlord and the cultivator in the proportion of 2.1. If the crop is poor, there may be nothing left after all the deductions are made and the cultivator will have to go away having only fed himself for 5 months. There are also other types of tenures covering small acreages. Sometimes there may not be direct negotiations between the landlord and the tenant. A middleman will assume the position of the landlord having paid a fixed rent to the actual absentee landlord. Except in a few cases where notarial agreements had been signed, there had been no security of tenure at all and tenants were victimised in most cases. No tenant attempts to improve the fields for fear of increase of rent as a result the next year. There is constant quarrel between landlords and tenants. A cultivator may lease out one field for the *maha* season and another field for the *yala* season far away.

**Paddy Lands Bill**. This bill was applied to the District in November, 1953, to cure the ills of the existing land

tenure system. The purposes of the bill were—

(*a*) to give security of tenure for a period of 5 years.
(*b*) to fix maximum rents payable to the landlord. 10 bushels or ¼ crop whichever is less per season per acre.
(*c*) to allow Government to take over uncultivated lands and get them cultivated.

During 1954 and 1955, the number of leases registered under this Bill were 1890 representing only 40 per cent. of the total number of leased holdings. The other landlords claimed that they have changed their system of cultivation to hired labour. As the bill did not clearly distinguish between tenants and hired cultivators it was not possible to take action against landlords. As the Bill stipulates a fixed rent contrary to age old customs in some areas it is difficult to check on the correct rent paid to the landlord. Thus the working of the Bill has so far not been very satisfactory and legislation to remedy the shortcomings is contemplated.

**Irrigation.** The 134,700 acres of asweddumized paddy fields in the District are distributed as follows :—

| | |
|---|---|
| Irrigated by Major Tanks | 71,700 acres |
| Irrigated by Minor Tanks | 10,200 acres |
| Rainfed | 52,800 acres |

There are 15 Major Schemes of which the important ones are—

| | |
|---|---|
| Pattipola Aru | 32,173 acres |
| Rugam | 8,145 acres |
| Vakaney | 7,282 acres |
| Manalpiddy Aru | 6,987 acres |
| Unnichchai | 5,883 acres |
| Sagamam | 2,846 acres |
| Rufus Kulam | 1,020 acres |

The Pattipola Aru is a branch of the Gal Oya. The three Tanks Kondavattavam, Amparai and Irakkamam and several anicuts in the Aru supply water to this Scheme During the North-East Monsoon season the river overflows and silts up all the paddy fields and no cultivation is possible. Thus this is essentially a *yala* season scheme. After the construction of the Senanayake Samudra at Inginiyagala, flood waters have been reduced to some extent and *maha* cultivation is now possible in some areas. These 32,173 acres are in one large block and form the largest single mass of paddy fields in Ceylon. The major schemes supply water for both *maha* and *yala* cultivations, more for *maha* than for *yala*. Water is issued from the tanks only after they are full in December and therefore all preparatory tillage operations and sowing are dependent on rain. This creates difficulties for transplanting and harrowing of the standing crop of paddy. The *yala* cultivation is fully irrigated and mud sowing is normally adopted. Due to the sandy nature of the soil, absence of concrete channels and the numerous sand dams that control irrigation, water is not available to many fields at the proper time and there is a large amount of wastage of water. There is constant trouble between cultivators in water issues during the *yala* season.

**Seasons.** There are 2 main seasons for cultivation. The *Manawari* (rainfed) and *munmari* (irrigated) correspond to the *maha* season. *Kalapokam* (irrigated) corresponds to the *yala* season. This is in contrast to the nomenclature in the Northern Province where *kalapokam* refers to the *maha* season. If there is extra water left in the tanks after the *yala*, a late *yala* or *idaipokam*

is also cultivated. The *manawari* fields are ploughed with the first rains in August or September and sown with 4 months paddy early in October. The *munmari* fields are also sown with 4 months paddy mainly during November and to a small extent in December. Sowing for the *kalapokam* season under the Pattipola Aru Scheme commences late in January and continues till March and for the other major schemes in April and May. 3 months paddy is only cultivated during *kalapokam*. Sowing for *idaipokam* is done with 3 months or 2½ months paddy in June and July. Along the borders of the 30-mile long lagoon, 5 months flood and salt-resistant paddy is cultivated during the *maha* season. Thus sowing goes on at one place or another for 10 months of the year continuously. This provides ideal breeding ground for most of the paddy pests. During 1955 the acreage sown for the *maha* season was 86,466 acres and for the *yala* season 46,116 acres. Most of the *maha* fields are separate from the *yala* fields and double cropping is done only in some areas. A very small extent of fields under the Pattipola Aru Scheme are cropped thrice a year.

**Improved Methods of Cultivation.** Due to the poor nature of the soil, large size of holdings, insecurity of tenure and unsatisfactory irrigation facilities the adoption of improved methods has been slow but steady progress has been recorded in recent years especially after the Guaranteed Price Scheme was introduced and the price raised to Rs. 12 per bushel of paddy.

(*a*) *Use of Light Iron Mould Board Plough.* During the last 6 years about 4,000 iron ploughs made at the Government Factory were sold to cultivators. Model C is the popular plough. 136 tractors of which 95 belonged to private individuals and 41 to Co-operative Agricultural Production and Sales Societies (C. A. P. & S. S.) are being used for ploughing. 47,500 acres representing 35 per cent. of the cultivated area are ploughed with light iron ploughs and tractors. Some fields cannot be ploughed and only mudding can be adopted. In the other areas the traditional old wooden plough is still being used.

(*b*) *Use of Pure-line Seed Paddy.* There are 23,500 acres representing 17 per cent. of the cultivated area under pure-line paddy. In addition to this, the 32,000 acres under the Pattipola Aru Scheme grow only Vellaiperunel and to a small extent Pachchaiperumal, the 2 pure-lines recommended by the Department for the *yala* season. As the purity of this paddy is not up to Departmental standards this area is not taken into account in the acreage under pure-line paddy. The variety Oddavalan is also grown in a small area for the *yala* season. The best variety for the *maha* season is Murungakayan. It is now replacing Vellai Ilankalayan which was formerly recommended. Perilanel is also grown in some areas during the *maha* season. The scheme of multiplication of pure-line paddy by private seed farmers has not met with much success because the seed farmers usually sell their produce for consumption owing to lack of storage space and want of immediate payment for their produce. Some of the C. A. P. & S. S. are helpful in purchasing and storing this paddy till sowing time.

(*c*) *Use of Manure.* Cattle manure, compost and green manures are applied in 11,400 acres and artificial fertilisers in 9,700 acres. Fertilisers subsidised by the State are only given through the

C. A. P. & S. S. and in those areas where these societies do not function satisfactorily the cultivators are not able to obtain the fertilisers. Yield increases up to 28 per cent. have been obtained by the use of fertilisers alone.

(*d*) *Weeding.* This is done by manual labour in 11,100 acres. As the paddy fields are situated far away from inhabited localities, it is necessary to transport labour for weeding. The cultivators have realised that the full benefits of fertilisers are not obtained without weeding. Weedicides have not yet become popular.

(*e*) *Harrowing the Standing Crop of Paddy.* An exent of 5,200 acres is harrowed when the crop is 3-4 weeks old. Lack of irrigation water during the *maha* season and the difficulty of access to the main masses of paddy fields after they are sown are the obstacles to the harrowing of greater acreages.

(*f*) *Transplanting.* Only 200 acres are transplanted. Although the benefits of transplanting have been effectively demonstrated in every village, the following fundamental difficulties prevent the large-scale adoption of this practice :—

(1) Large size of holdings

(2) Insufficient labour

(3) Lack of irrigation water for raising nurseries during the *maha* season.

(4) Short-term paddy. During the *yala* season when irrigation water is available only 3 months paddy is cultivated and it has been found uneconomical to transplant such paddy.

(*g*) *Saline Paddy.* The local variety, Uvarvellai, and the introduced variety, SR 26, are grown in 90 acres.

**TABLE 2—Progress in the Adoption of Improved Methods of Paddy Cultivation**

| | *Use of Iron Ploughs and Tractors* *Acres* | *Use of Pure-line Paddy* *Acres* | *Use of Fertilisers* *Acres* | *Harrowing the Standing Crop* *Acres* | *Transplanting* *Acres* |
|---|---|---|---|---|---|
| 1949 | 5,000 | 2,200 | 800 | 270 | 60 |
| 1950 | 7,000 | 5,000 | 1,942 | 500 | 72 |
| 1951 | 14,000 | 7,100 | 1,357 | 840 | 115 |
| 1952 | 30,000 | 9,280 | 4,690 | 1,610 | 120 |
| 1953 | 40,000 | 11,900 | 8,560 | 3,650 | 70 |
| 1954 | 46,000 | 23,300 | 9,700 | 4,800 | 210 |
| 1955 | 47,500 | 23,500 | 5,560* | 5,200 | 200 |

* This reduction in acreage is due to the non-availability of fertilisers at the C. A. P. & S. S. which controlled the State subsidised fertiliser scheme.

**Pests and Diseases.** Owing to continuous cropping of paddy, pests are of regular occurrence. The Paddy Swarming Caterpillar occurs every year during the months of February and March under the Pattipola Aru Scheme. If there is sufficient irrigation water, not much damage is done as the caterpillars cannot damage the plants below water level and as they float in the water they can easily be collected and buried. But if no water is available, very serious damage is done. Spraying with DDT has become a popular control measure in

recent years. The Paddy Bug is the other serious pest. It is controlled by dusting with BHC or spraying with DDT. The Paddy Stem Borer is controlled by routine spraying with Endrin or Folidol and Paddy Leaf Roller by dusting BHC. Among diseases, Blast and Brown Spot have been rapidly increasing in recent years. Disinfection of seed by Perenox or Ceresan Wet is an effective control measure.

**Mechanisation.** Owing to the large size of paddy holdings this District offers great scope for mechanisation of paddy cultivation. There is also shortage of labour due to the large-scale recruitment by the Gal Oya Development Board. The number of tractors used for paddy cultivation increased from about 10 in 1950 to 136 in 1955. Medium-sized rubber wheeled tractors are popular. They are used for ploughing, harrowing, tyne tilling and threshing. Combine harvesters cannot be successfully used owing to the numerous paddy field ridges and the uneven nature of the fields. Earth-moving machinery is in great demand for levelling work. But the attachments to the small tractors to do this work have not produced satisfactory results. There is no organization to purchase and work heavy tractors which alone can perform this job. Aerial spraying against paddy pests is possible in the 32,000-acre block of Patipola Aru paddy fields. The Eastern Province Co-operative Agricultural Societies Union is the local agent for one make of medium sized tractors and has done very useful work in furthering agricultural mechanisation in the District.

**Co-operative Agricultural Production and Sales Societies.** These Societies have increased from 16 in 1950 to 55 in 1956. Originally they were interested only in the marketing of paddy. But gradually some of them were made to take an increasing interest in production activities. They did useful work in selling Light Iron Ploughs, Artificial Fertilisers, Pure-line Paddy and Insecticides. They maintain 41 tractors for hire to cultivators.

**Highland Crops—Coconuts.** Next to paddy, coconuts cover the largest cultivated acreage. There are 18,900 acres of which 60 per cent. is in the narrow 20 miles long belt between Kalkudah and Batticaloa. Most of the estates are in a very neglected state. The soil is very sandy and due to the long dry period of the year, the useful life of the plant is reduced to a great extent. As very little replanting has been done, there are several vacancies and the average pluck will not exceed 400 nuts per year per acre. There are a few estates that give 1,000 nuts per year per acre. The estates in Akkaranipattu area which accounts for 20 per cent. of the total extent are in a better state. Most of them are ploughed by tractor before the monsoon rains and kept in good condition. Even these estates compare unfavourably in yields with estates on the South-West coast of the island owing to the sandy soil and the long drought experienced here. 60,000 seedlings raised in the Batticaloa nursery from nuts supplied by the Coconut Research Scheme were sold to estate owners and colonists for planting during the last 7 years. Outbreaks of the leaf-eating caterpillar occur every year and are controlled by the liberation of the *Eulophid* parasites.

**Cashew.** This is now grown in about 450 acres along the coast from Kalkudah to Kaluwanchikudy. The nuts produced

are mainly consumed locally with very little sent to Colombo and Jaffna. This crop can be extended to about 5,000 acres along the coastal belt on poor soils that are unsuitable for any other crop and an export market developed for this commodity. Peasants have been encouraged to plant more cashew in their home gardens. Capitalists are reluctant to put money into this crop because of the long waiting period to get returns which are small.

**Mango.** There are about 200 acres of mangoes mainly grown as a home garden crop. Most of the varieties are sour. There is good scope for the extension of this crop and the introduction of good varieties. The crop does well throughout the District both along the coast as well as the interior. 12,600 mango grafts of selected varieties obtained from Jaffna were sold during the last 7 years.

**Citrus.** There are about 800 acres of limes and oranges mainly grown in the Maha Oya area which adjoins the citrus-growing areas of Uva. These gardens are in a poor state because no irrigation is available during periods of drought and the villagers are more interested in their chenas during the rainy season. 5,300 orange grafts and 4,600 lime seedlings were sold for planting during the last 7 years.

**Vegetables.** About 1,000 acres of vegetables are grown mainly in *chenas* and to a small extent as a home garden crop under irrigation. Better varieties of seeds and seedlings are regularly issued to cultivators to improve the quality. A peculiar feature about irrigated brinjal cultivation in some areas is the injection of very small quantities of mercury into the barks of seedlings. By means of this very old practice, large-sized fruits are produced.

**Tobacco.** About 100 acres of cigar tobacco are grown on the banks of rivers by lift irrigation. But Muslim cultivators from Eravur go in large numbers every year to Tamankaduwa to cultivate tobacco on the banks of the Mahaveli ganga and bring the cured product home for sale to Jaffna traders through their Co-operative Society. Cigarette tobacco is now being grown with success in the Gal Oya Valley with restricted irrigation.

**Chena Crops.** About 10,000 acres of chenas are cultivated every year in which the important crops are :— Manioc 3,000 acres, Maize 2,700 acres, Kurakkan 1,100 acres, Chillies 1,000 acres and Plantains 700 acres.

**Animal Husbandry.** The following livestock are found at present :—

| | | |
|---|---|---|
| Cattle | .. | 75,000 |
| Buffaloes | .. | 64,000 |
| Goats | .. | 14,000 |
| Poultry | .. | 73,000 |

There is good scope for the development of animal husbandry in the District. Even now at least 100 fowls are sent by train to the Colombo Hotels every day. Waggon loads of cattle and buffaloes are also sent for slaughter. But systematic breeding or management has been adopted only in a few cases. Cattle and buffaloes are allowed to graze in paddy fields after harvest and during the paddy season they are sent to uncultivated areas away from paddy fields. Very little stall feeding is done. Cultivation of fodder and pasture is negligible. Few cows and buffaloes

are milked, the latter for the preparation of curd. Many landlords own large herds. Some of them are kept in coconut estates for manuring. Others roam all over the place doing considerable damage to cultivation. In order to undertake systematic improvement of the cattle and buffaloes, it is felt that the present numbers are far too many in view of the limited pasture lands available. This does not apply to goats whose numbers have been falling in recent years. Most of the natural pasture lands of ancient times have now been converted into paddy fields and the Gal Oya Development Board has taken over large areas. As a result of representations made to the Board, 26,575 acres have been set apart in 4 large blocks on the Left Bank of the Gal Oya for pasture. Even with this provision it is necessary to reduce the cattle and buffaloes to half their present number to undertake scientific breeding and management. The reduced numbers are quite sufficient for agricultural purposes in view of the large number of tractors working at present. Some improvement to the livestock has been made by the adoption of the following measures :—

(*a*) **Cattle.** Seventy-two Stud Bulls of the Sindhi and Khillari Breeds have been issued in the villages for crossing local cattle. Some of these have been given on loan and others in exchange for local scrub bulls. 900 cross-bred calves have been born during the last 7 years. Castrations of local bulls have been done, but owing to the very large number of bulls roaming about, these have not produced useful results.

(*b*) **Buffaloes.** Seventeen stud buffaloes of the Murrah breed have been issued on loan and in exchange in the villages for crossing local buffaloes. 500 cross-bred calves have been born during the last 7 years.

(*c*) **Goats.** Ten Jamnapari stud goats have been issued for crossing local goats. Three Co-operative Goat Farming Societies were started but these did not fare well. There is scope for the development of more goat breeding in the district.

**Poultry.** Few districts in Ceylon offer more opportunities for poultry-keeping than this Division. 52,000 pure-bred eggs of the R I R and Australorp breeds were sold to villagers for hatching during the last 7 years and 800 cockerels of the same breeds were issued in exchange for village cockerels. Large-scale inoculations against Pseudo Fowl Pest have been done in the coastal area. But numerous deaths due to this disease still occur in the interior areas where it has not been possible to inoculate all the birds due to poor transport facilities.

**Stud Centres.** There are 3 Stud Centres at Batticaloa, Mavadipalli and Akkaraipattu where free service is given by stud bulls and goats of improved breeds to villagers' animals. Although the stud goats were well patronised, the services given by the bulls were few. This is due to the fact that very few cattle are kept in the homes and stall-fed.

**Gal Oya Scheme**. This is the largest multi-purpose project ever undertaken by the Ceylon Government. It will bring in 72,500 acres of new irrigable land and give an assured supply of irrigation water to 51,640 acres of privately owned old fields including the famous Pattipola Aru fields. The Scheme is in charge of the Gal Oya Development Board set up

by Act of Parliament in 1949. At the end of 1954-55, 4,780 families consisting of 33,000 persons had been settled by the Board in 34 new villages. Of these 2,884 families come from outside the Batticaloa District. Up to 1953, each family was given 4 acres of irrigable land and 3 acres of highland but these were later reduced to 3 acres and 2 acres respectively. During 1953-54, an extent of 2,600 acres was set apart for middle class colonists at the rate of 25 acres per holding with 12 acres irrigable and the balance under light irrigation. In order to ease the congestion along the old coastal villages, 4,160 acres were alienated to selected peasants, each holding being 3 acres irrigable and 1/3 acre highland. Throughout the development of the scheme so far, mechanised equipment has been used in clearing jungle and 65,000 acres have been cleared in this manner. After the construction of Senanayaka Samudra which is the main tank in the Gal Oya Scheme, several irrigation and drainage problems which existed in the Pattipola Aru Scheme have been solved to some extent. A greater area is now being cultivated and it is possible to grow a 4-months paddy during the *maha* season in a substantial acreage which formerly grew only a 3-months paddy during the *yala* season. It is even possible to get 2 crops a year where only one was cultivated before. But the policy of the Board is to have only one crop of 5-6 months paddy a year during the *maha* season and to grow subsidiary crops like tobacco, chillies and onions with restricted irrigation during the *yala* season. Considerable success has been achieved in growing cigarette tobacco in this manner and incomes of Rs. 1,000 per acre have been obtained by several colonists.

**Government Farms.** There is only one farm at Karadian Aru, 400 acres in extent. 150 acres of paddy, 5 acres of mangoes and 10 acres of other highland crops are cultivated. There are also Nursery, Dairy and Poultry sections. There is a Practical Farm School for Boys in this farm where 35 students follow a one-year course. A new 200-acre farm is being opened on the Samanturai-Amparai Road to serve the needs of Batticaloa South. It is proposed to shift the Boys' Farm School there and convert the school at Karadian Aru into a Girls' Farm School.

**Future Prospects.** As the Gal Oya Scheme progresses, it is bound to have its effects on the agricultural development of the District. It has already had some effects. It has made the cultivators tractor minded. It has helped in the growing of a 4-months paddy in a traditionally 3-months area. It has shown that cigarette tobacco can be grown with success.

Increasing of paddy yields will continue to be the main task for the future. In spite of the poor soil, the Karadian Aru farm gave 48.7 bushels per acre in 150 acres during the 1954-55 *maha* season when the District average was only 29.5 bushels per acre. The methods adopted at Karadian Aru have been demonstrated in villagers' fields in every paddy tract in the District. If problems like tennure, irrigation, levelling of fields, etc., are solved it should be possible to bring up the District average to the Karadian Aru figure. Sales of subsidised fertilisers by CAP & SS should be looked into and every Society compelled to have sufficient stocks for all cultivators. The growing of 4-months paddy under the Pattipola Aru Scheme opens the way for the large-scale

adoption of transplanting during the *maha* season. In this thickly populated area with a fairly fertile soil and ample water from the Senanayake Samudra, transplanting can be made a success. 2.4 million bushels of paddy were purchased under the G. P. S. in the District during 1955. It is possible to increase the figure to 4 million bushels in a few years.

Increased cultivation of cashew and improved varieties of mango are two other important projects. Some form of State assistance for cashew cultivation and the production of large numbers of mango grafts in the Karadian Aru Farm for sale to growers are necessary.

The coconut estates need replanting and rehabilitation urgently. It is hoped that many proprietors will make use of Government assistance in this respect.

Among the animal husbandry projects very quick progress can be made in poultry. It is possible to eliminate the local birds entirely in a few years and replace them with either pure birds or crossbreds. Inoculations against Pseudo Fowl Pest should be done on a very much larger scale than at present. With regard to cattle, buffaloes and goats, a well planned programme of development is necessary. The reservation of 26,575 acres of pasture land by the Gal Oya Development Board gives a good oportunity to develop grazing lands on scientific lines and organise stock breeding and maintenance. The newly-formed Stock Breeders Association will also be of help in this venture.

# Pineapple and Cacao Mealy-bugs of Economic Importance in Ceylon

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## Introduction

Mealy-bugs are a group of insects responsible for considerable damage to agricultural crops. This damage is always associated with the feeding of the insect and may be caused by (*a*) the depletion of plant nutrients by the sucking up of the plant sap and thereby causing a loss of vigour, stunting and even death of plants, or (*b*) the injection into the plants of toxins which form part of the salivary secretions of the insect and cause pathological reactions in the plant strongly reminiscent of a plant disease, or (*c*) the transmission of plant diseases from diseased to healthy plants. The economic importance of mealy-bugs to agriculture in Ceylon at present centers chiefly around the toxic effects one species of mealy-bug induces in the pineapple plant and the trasmission of a virus disease by other species in the cacao crop. While some work had been done by both the Division of Plant Pathology and the Division of Entomology on these two important aspects of mealy-bug damage in Ceylon until 1953, the work of Dr. Walter Carter, conducted during an F.A.O. assignment in Ceylon in that year served to clarify some features of these problems and also as a basis for intensified studies in this field of work. Dr. Carter's observations during his stay in Ceylon have recently appeared in the F. A. O Bulletin (1956). The purpose of this article is to describe the nature of the problems involved and to review some of the results of studies on pineapple and cacao mealy-bugs.

## Mealy-Bugs and Pineapple Wilt

**Etiology of Pineapple Wilt.** The relationship of the mealy-bug, *Pseudococcus brevipes* (Ckl.), to wilting in pineapple plants was first suggested by Illingworth (1931) working in Hawaii and the nature of this relationship was conclusively elucidated by Carter (1933). This mealy-bug was first recorded in Ceylon in 1926 but the affliction of pineapple plants by wilt was first diagnosed as mealy-bug induced pineapple wilt by Pieris (1950) on the basis of the symptoms exhibited by affected plants and confirmed by Carter (1953) by artificial infestation experiments. Pineapple wilt is found today wherever pineapples are grown in Ceylon.

Carter (1945) classified the sequence of symptom development of pineapple wilt into four stages with a fifth indicating a recovery stage. Stage 1 involves the preliminary reddening of the leaves. In stage 2 a definite colour change from red to pink occurs accompanied by a reflexing of the leaf margins (Plate 1). In stage 3 the affected leaves loose their

Plate 1—Series of wilting plants in foreground. Note the reflexed edges and loss of turgor of the leaves

Plate 2—Wilted plants showing almost complete disintegration of root system

turgor and droop and in stage 4 the affected leaves have dried up for the greater part of their length. The death of the root system accompanies the other symptoms (Plate 2). According to Carter (1945) a relatively small proportion of plants develop to stage 4, stage 3 usually being followed by recovery. In Ceylon the reverse appears to hold true as once wilt appears in a plant it proceeds through all its phases until the plant ultimately dies and recovery of plants from wilt is relatively rare. This may be due to the absence of effort to control the damage at this stage.

A common observation on pineapple wilt, when it first appears in a new planting, is that it commences from the edge of the planting and spreads inwards. This led to its being referred to as "edge wilt" in Hawaii. This phenomenon of "edge wilt" is the result of invasion of the new planting by mealy-bugs carried by ants from wild alternate host plants at the boundaries of the plantation. Wherever suckers used for planting are infested with mealy-bugs and no effort had been made to disinsect these suckers prior to planting, however, wilt develops at random within the plantation. Both conditions have been recognized in local pineapple plantations.

In Hawaii several alternate host plants of *Pseudococcus brevipes* have been identified (Carter 1951) but in Ceylon to date the only alternate host identified has been the thorny leafed *Bromelia pinguin*. This plant is commonly grown on boundaries of pineapple and other plantations particularly in the Western Province.

All the symptoms of pineapple wilt are strongly suggestive of a virus disease, but Carter (1953) has produced conclusive evidence that a toxin secreted by the insect and not a virus is responsible for wilt of pineapples. Some of the strongest points in favour of the toxin idea are (*a*) that complete recovery of plants from wilt is possible if the mealy bugs are controlled, (*b*) that the symptoms of wilt cannot be induced in any other plant, (*c*) that the capacity to produce wilt is inherent in the insect, and (*d*) that vegetative propagations from wilted plants are wilt-free.

Pineapple wilt does not develop in plants immediately feeding by mealy-bugs takes place and furthermore not all plants infested by mealy-bugs will eventually develop wilt. While occasional plants may develop symptoms of wilt after being fed upon by even a single mealy-bug, most plants require larger numbers of bugs feeding for a length of time before wilt symptoms will appear. Carter (1937) has established that the percentage of plants developing wilt as a result of infestation by mealy-bug colonies of varying size varied with the number of mealy-bugs involved. Furthermore there is considerable variation in the susceptibility of individual plants to wilt. On younger plants, ranging around 5 months old, Carter (1945) has found that the period between mealy-bug feeding and the appearance of symptoms of wilt is between 58 and 77 days with a mode at 70 days whereas for older plants about 9 months old when first feeding by mealy-bugs took place, the period required for appearance of symptoms was between 82 and 181 days with a considerable number of cases requiring much longer periods. From limited experiments done in Ceylon it has been observed that a period of about 65 days

was required for the appearance of wilt symptoms after feeding by mealy-bugs on 6-month old plants.

The influence of fertilizers on the susceptibility of pineapple plants to wilt has been studied by Carter (1945 *a* and *b*). He found that plants grown at various levels of nitrogen, phosphorus, potassium, calcium and iron showed no variation in susceptibility to wilt. He also found that recovery of plants from wilt was influenced by nitrogen fertilization but the age of the plant at the time of infestation with mealy-bugs was a factor in this respect.

**Biology of the Pineapple Mealy-bug.** The life history of the pineapple mealy-bug is of special interest on account of the presence of several strains of this insect (Carter 1933 a; Ito 1938). In Hawaii a pink strain and gray strain of this mealy-bug have been recognized. The pink strain reproduces parthenogenetically with no males present and its members are not responsible for the production of green spots surrounding the point of feeding on the leaves. The gray strain reproduces sexually and causes green spotting on leaves. Both strains are viviparous and capable of causing wilt. While a colour distinction has not been observed between the strains of this mealy-bug in Ceylon, a distinction of strains into parthenogenetic and sexual forms has been found to exist here. To date only the sexual green-spotting strain has been observed in the western province while the parthenogenetic form has been recognized in the Bibile area. The detailed biology of this insect in Ceylon will be reported elsewhere.

Mealy-bugs are found on pineapple plants especially located under the basal portions of the leaves. As the colonies of these bugs increase in size they may be found on the exposed parts of leaves (Plate 3), on fruits when present and on the subterranean parts of plants such as the butt and roots. Mealy-bug populations have been found to be particularly heavy in the basal regions of the plants in the plantations where coconut fibre dust has been used as a mulch for weed control. The conditions of moisture content and of general protection afforded by the mulch surrounding the base of the plants are very favourable for the build-up of the mealy-bugs. This mulch, unless removed, renders insecticidal control of the mealy-bugs extremely difficult.

Pineapple mealy-bugs are always found associated with various species of ants. In Ceylon the ants *Solenopsis* sp. *Paratrechina longicornis* Latr. and *Bothriomymex wroughtoni* Forel have been found in association with the pineapple mealy-bug. *Bothriomyrmex wroughtoni* has to date been found only in the western province and is of special interest because it constructs extensive earthen galleries, very similar to those constructed by termites, as a protective roofing over the mealy-bug colonies thus making the latter insect less accessible in the normally exposed parts of the plant to insecticidal treatment. The function of the ant associates of mealy-bugs is two-fold, viz., the consumption and therefore the disposal of honeydew excreted by the mealy-bugs and the dissemination of the mealy-bugs from plant to plant. With the progressive development of symptoms of wilt in pineapple plants, ants invariably remove the mealy-bugs from such plants to wilt-free healthy plants.

Plate 3—Pineapple plant infested by mealy bugs on under-surface of basal parts of the leaves. The remnants of the earthen galleries formed by the ant [illegible] can be seen on some leaves

**Control of Mealy-bugs and Wilt of Pineapple**. The control of this pest and therefore the wilting of pineapple plants can broadly be divided into three phases, viz., (*a*) the production of mealy-bug-free planting material, (*b*) the control of ants and thereby the prevention of the dissemination of the mealy-bugs in the field, and (*c*) the control of mealy-bugs occurring on plants in the field by insecticidal methods. In Hawaii it was found that the spread of wilt into a plantation from its boundaries was slower across rows than along rows (Carter 1932). Several rows of plants were therefore planted parallel to the boundary of the plantation as barrier rows to retard the spread of mealy-bugs into the plantation. Insecticidal treatments were concentrated on the barrier rows. While the planting of barrier rows of pineapple plants is to be recommended for implementation in Ceylon it is more important that the practice of the improper use of coconut fibre dust as a mulch on pineapple plantings should be avoided if mealy-bug populations are to be minimized. The quantity of this mulch around each plant should not exceed one inch in depth otherwise it provides ideal moisture conditions and protection for the heavy build-up of mealy-bug colonies at the base of the plant and renders such colonies of bugs inaccessible to insecticidal control measures.

The earliest insecticidal treatments for the control of pineapple mealy-bugs were oil emulsions and with the advent of DDT a measure of control was achieved by using high concentrate emulsions of this insecticide. It was however not until the organophosphorus insecticides became available that effective control of mealy-bugs became practicable. Published data on insecticidal control of this pest are scarce. However Carter (1952) has reported the results of the comparative tests with a series of organophosphorus insecticides (parathion, malathion and systox) in the control of this insect.

**Insecticidal Trials for the Control of Pineapple Mealy-bugs and Wilt.** We have conducted a series of experiments towards (*a*) development of simple chemical techniques for obtaining mealy-bug free planting material, (*b*) the control of ants within a plantation, and (*c*) the control of infestations of mealy-bugs existing on plants in the field.

Detailed descriptions of these experiments and the data obtained will be published elsewhere. However a summary of some of the results achieved is given below.

(*a*) *The Control of Mealy-bugs on Suckers intended for Planting.* If the spread of mealy-bugs and wilt is to be prevented and if new plantings are to be maintained free of mealy-bugs it is of prime importance that the suckers used in the new planting are free of mealy-bugs before they are planted. In the earliest tests conducted with this end in view fumigation of the infested suckers with hydrocyanic acid gas and methylbromide gas was carried out. While both these fumigants proved effective in disinsecting the suckers it was felt that fumigation as such could not be practised by the average grower in Ceylon. A simpler method of disinsection of suckers was therefore devised. This consisted of rapid dipping of the suckers, butt first, into a diluted emulsion (in a 4-gallon bucket) of any of the organophosphorus chemicals, malathion, diazinon or parathion, and then stacking the suckers in an erect

position, for at least 24 hours so that accumulation of the insecticidal emulsion would be retained at the leaf bases for some time to percolate into the spaces between the leaf bases and affect the mealy-bugs present. By this method complete control of the mealy-bugs present in suckers has been achieved when approximately 0.05 per cent. malathion, .025 per cent. diazinon or .01 per cent. parathion emulsions were used for the dip treatment. The chlorinated hydrocarbon insecticides such as DDT, BHC, etc., even as high concentrate emulsions, gave poor control of the insects by this method.

(c) *The Control of Mealy-bugs on Plantation.* Formicides such as aldrin, dieldrin and chlordane sprayed around the bases of the plants have been found effective in controlling ant populations associated with mealy-bugs but no formicidal treatments have been tested so far with a view to eliminating entirely all ants from pineapple plantations. However the spray treatments found satisfactory in the control of field infestation of mealy-bugs on pineapple plants have also proved very effective in the control of the ant associates.

(c) *The Control of Mealy-bugs on Growing Pineapple Plants in the Field.* Mealy-bugs are located chiefly under and between the leaf bases of pineapple plants, extending from growing point to the butt. When colonies of bugs increase in numbers to a point where this region of the plant becomes overcrowded the bugs spread out to the roots, exposed parts of the leaves and various parts of the fruits, when present. Exposed colonies of bugs present on the plants are relatively easily controlled by direct contact sprays of organophosphorus insecticides. Colonies existing between the leaf bases present some problems for their control, while those found in the roots and the sub-surface parts of the butts of the plants are most difficult to control. Tests have been carried out both in the laboratory and in the field where insecticides have been employed either as contact or as systemic sprays for the control of field infestations of this bug. Nearly complete control of the butt and leaf base colonies of the pest has been achieved by spraying the plants and especially the basal regions of the leaves with a 0.05 per cent. malathion, 0.025 per cent. diazinon or a .01 per cent. parathion spray in the emulsion form. The best results were achieved where the leaf bases were cleared of all debris and as much as possible of the butt region of the plant exposed after removal of the older dead leaves before spraying. Spraying was of the high volume type using a knapsack sprayer and spraying at the rate of at least 250 gallons of prepared spray per acre. Special care had to be taken to ensure that the spray liquid accumulated in small quantities at the leaf bases if complete control of the bug was to be achieved. Laboratory studies using the organophosphate insecticides malathion, diazinon, parathion, chlorothion, dipterex, ekatin and metasystox against leaf colonies of pineapple mealy-bugs have confirmed the efficacy of these insecticides as contact sprays against this pest. The two systemic insecticides ekatin and metasystox which show distinct systematic activity against plant sucking bugs on other crops had no activity whatsoever against the mealy-bugs on pineapple when tested for systemic action. Carter (1952) reported similar results with another systemic insecticide, systox.

**Present Position relating to Pineapple Wilt Control in Ceylon**. Although relatively effective measures are now available for the control of pineapple wilt, the average grower has not yet fully understood some of the most salient features of the causal basis of wilt and has therefore not implemented as he should a proper wilt control programme on his plantation. The prime concern of the grower should be the planting of mealy-bug-free suckers in all new plantings. It is much simpler to control mealy-bugs on suckers than to control them on growing plants in the field for the reason that in the latter condition mealy-bugs are frequently present in the lower regions of the butt of the plants or even the roots both of which are not easily accessible to attack by insecticidal sprays. When completely disinsected suckers have been planted in a new planting the grower should concentrate his attention to maintaining his new planting mealy-bug-free. This can only be achieved by routine observation of the planting for the presence of mealy-bugs, and the prompt spraying of every infested plant and also the neighbouring plants. More often than not however the grower considers spraying his crop only after wilt has developed in his plantation. Spraying at this stage generally gives poor results in wilt control as toxic levels of mealy-bug feeding have already occurred in many of the symptomless plants and in time wilt symptoms appear (as would theoretically be expected) in spite of the spraying. The grower is then disappointed with the results of the spraying. What the grower should concentrate on therefore is not the spraying of the crop when wilt appears but the control of mealy-bugs on his crop as soon as they appear and thereby reduce the chances of feeding by these insects to toxic levels which would inevitably result in wilt. If timely spraying is carried out and even if early symptoms of wilt develop, the plants, particularly if young, should not be abandoned as lost because the complete control of the bugs coupled with heavy nitrogen fertilizer treatment will help greatly in the recovery of the plants.

Many growers have had the experience of finding pineapple plants heavily infested with mealy-bugs but not developing wilt. They have therefore hurriedly concluded that this observation invalidates the view that mealy-bugs are responsible for pineapple wilt. This may however be accounted for by the fact that (*a*) the plants are of low susceptibility to the mealy-bug toxin causing wilt, (*b*) the strain of the bugs involved may be of low toxic value so that a toxic dose of salivary secretion for the development of wilt does not build up in the plants, (*c*) the time required for the development of wilt symptoms after the first feeding by mealy-bugs may not have yet been passed.

The use of coconut fibre dust, available in large quantities particularly in the western province, as a heavy surface mulch on pineapple plantations has its advantages in that good weed control is achieved and ideal moisture levels are maintained at the base of the plants. This practice has however encouraged the heavy build-up of mealy-bug populations at the base of the plants protected by the mulch. This mulch also renders the basal infestations of mealy-bugs inaccessible to insecticidal sprays. If both the advantages of the mulch and wilt control are to be obtained the base of the plants should be kept clean

and the mulch should be reduced to a maximum of one-inch depth around the plants.

## Mealy-bugs and Cacao Virus

**Field Observations on Cacao Mealy-bugs.** Three species of mealy-bugs are commonly found on cacao plants in Ceylon. These are *Pseudococcus lilacinus* (Cockerell). *Pseudococcus citri* (Risso) and *Ferrisia virgata* (Cockerell). While *P. lilacinus* is the dominant species of mealy-bug on cacao *P. citri* and *F. virgata* are to be found in much smaller numbers on this crop. *Pseudococcus lilacinus* and *P. citri* are to be found in particularly large infestations on pods when these are present and in smaller colonies or as individuals on leaves, stems, flower cushions and trunks of the plants. *Ferrisia virgata* is to be found chiefly on flower cushions and on stems.

All three species of mealy-bugs have powerful ant associations. *Pseudococcus lilacinus* and *P. citri* are most frequently associated with the large red ant, *Oecophylla smaragdina*. Other ants found in association with *P. lilacinus* are *Solenopsis nitens* Bingham, *Technomyrmex detroquens* Walker and *Odontomachus haematoda* L. These ants are responsible, to varying degrees, for the protection of the mealy-bugs against parasites and predators, the consumption of honeydew excreted by the bugs and the dissemination of mealy-bugs. Among the several species of ant associates of the mealy-bugs on cacao only *O. smarajdina* is entirely tree-nesting.

Of the various natural controlling factors of mealy-bugs of cacao in Ceylon, predatism by larvae of the Lycaenid butterfly *Spalgis epius* and the Coccinellid beetle *Exochomus nigromaculatus* may be mentioned. Furthermore the abundance of mealy-bug populations on cacao has been observed to be seasonal. High populations of these insects are observed during prolonged spells of dry weather, with such populations dwindling with the rains.

**Transmission of Cacao Virus by Mealy-bugs**. The virus disease of cacao was first indentified by Pieris (1953). Carter (1956) in 1953 conducted studies on the insect transmission of the cacao virus in Ceylon. This worker obtained positive transmission of the disease with *P. lilacinus* and *P. citri* but was not able to obtain transmission of the disease by *F. virgata*. In view of the fact the *F. virgata* is known to transmit the cacao virus in the Gold Coast (Posnette 1947) intensive transmission experiments were pursued with this mealy-bug but no positive transmission was achieved although over 200 seedlings were used in the tests.

**Relationship of Cacao Virus to Vein-flecking on Dadap**. Pieris (1953) has described the virus-like symptoms observed on the leaves of dadap trees, *Erythrina lithosperma*, commonly grown for shade on cacao plantations and has suggested that this plant might be an alternate host of the local cacao virus. Insect transmission studies were therefore conducted with a view to investigating a possible relationship between the cacao virus and the vein-flecking symptoms on dadap leaves. Gravid females of *P. lilacinus*, *P. citri* and *F. virgata* were caged on cacao leaves showing virus symptoms and on dadap leaves showing vein flecking symptoms. After five days the crawlers which were obviously feeding upon the

leaves were carefully removed and used for infection feeding. Crawlers from the dadap leaves were introduced on to germinating cacao seeds as described by Posnette (1947) while the crawlers from the cacao leaves were introduced between the cotyledons of germinating dadap seeds where they settled down to feed around the plumule. Close observation of the plants grown from these seeds showed no development of any abnormal appearance in the leaves. It would appear therefore from these experiments that the cacao virus is not transmissible to dadap by the species of mealy-bugs known to transmit the disease among cacao plants and that the vein flecking symptoms observed on dadap leaves are not likely to be related to the cacao virus.

**The Control of the Cacao Virus**. Unlike the cacao virus of the Gold Coast no spectacular damage has been done to the cacao crop in Ceylon by the existing cacao virus disease. While the disease is noted to be spreading, this virus, as a single factor, cannot definitely be said to be either reducing the vigour of the plants or the yield of the crop. No serious effort has therefore been made to control the mealy-bug vectors of this virus disease. Attempts to control the spread of this disease by the insecticidal control of mealy-bugs in the Gold Coast, where some of the most potent modern systemic insecticides have been used have not yet proved successful. The control of mealy-bugs on cacao by controlling ant associations through simple barrier treatment on trunks of the infested trees will meet with little success in Ceylon on account of the tree-nesting habit of the predomint ant species, *Oecophylla smaragdina*. It is therefore fortunate that the strain of cacao virus found in Ceylon at present is not a virulent one.

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# Notes on Some Mealy-bugs *(Coccidae)* of Economic Importance in Ceylon

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THE *Coccidae* or scale insects of Ceylon were the subject of a new classical taxonomic treatise by Green (3). This report covers studies on the economic importance of several species of mealy-bugs, undertaken as part of an FAO project, in the Entomology Section, Department of Agriculture at Peradeniya, in 1953.

Included are the results of experiments on the transmission of cacao virus, the confirmation of a previous diagnosis of mealy-bug wilt of pineapple by experimental mealy-bug infestation and the establishing of a *Pseudococcus* sp. as the cause of a malformation of kapok (*Ceiba pentandra*) seedlings.

## Cacao Virus

Cacao virus disease was first noted in 1949 by J. W. L. Pieris of the Ceylon Department of Agriculture, who submitted leaves showing the typical oak-leaf pattern to A. F. Posnette, then of the West African Cacao Research Institute, for diagnosis.[2] Posnette confirmed Pieris' opinion that the symptoms were similar to a strain of swollen shoot in West Africa. Although my own experience with the swollen shoot disease complex was limited to a few months spent as a member of the Swollen Shoot Commission, the leaf symptoms as observed in the Peradeniya area were typical of those seen in West Africa, although the rounded fruit was seen only once, and the swelling of the stems not at all. The leaf symptom is a striking oak-leaf pattern.

In view of the diagnoses on the basis of leaf symptoms, the known role of mealy-bugs as vectors, and the frequency of mealy-bug infestation on cacao in Ceylon, the necessity for the testing of these mealy-bugs was clearly indicated.

Three species of mealy-bugs were found on cacao. Of these, *Pseudococcus lilacinus* (Cockerell) was by far the most common. *P. citri* (Risso) and *Ferrisia virgata* (Cockerell) were found only on occasion, the latter being almost invariably associated with the flower pads on the tree trunks.

The technique of transmission was essentially that described by Posnette (4) with a modification that eliminated the dissection of the bean. The latter resulted in too high a percentage of

[1] Economic Entomologist (Tropical), Agriculture Division, F. A. O., 1953.

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[2] Oral communication.

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rotted beans under the local conditions for growing the seedlings. Beans were washed clean and set in large Petri dishes on moist paper. Large numbers of mealy-bugs from diseased trees were then introduced into these dishes and a fair proportion settled on the beans. From two to four days later, the beans were planted in flats and grown in a large screened cage.

Using this technique, positive results were obtained with *Pseudococeus lilacinus* and *P. citri*. Experiments with *Ferrisia virgata* were inconclusive up to the time I left Ceylon. In the positive cases, the first symptom was vein-clearing, which developed in approximately two months. The typical oak-leaf patterns developed on later flushes.

The experimental results made it clear that mealy-bugs are the vectors of cacao virus in Ceylon, and indicate equally clearly that the virus is closely related to the swollen shoot complex of West Africa. In the absence of comparative yield records, no positive estimate can be made of the debilitating effects of the virus disease on the tree but from observation in the field on the vigor of infected trees, it seems likely that the disease is actually a mild one. Sickle-leaf (a deficiency disease), the activities of *Helopeltis*, and black-pod disease (*Phytophthora palmivora*) are probably of far more economic importance. Even granting this to be true, however, control of cacao virus is desirable. Fortunately most of the cacao plantings in Ceylon are plantation style and except for extremely hilly locations, lend themselves in some degree to mechanical spray control methods. Formicidal sprays could well be combined with sprays against *Helopeltis* and with suitable formulations effective against black-pod disease. Cutting out of diseased trees would need to be resorted to only in the most extreme cases. This solution, however, will require the accumulation of more basic data than was available at the time, on the one hand, and the informed co-operation of the cacao growers on the other.

**Mealy-bug Wilt of Pineapple**

This disease of pineapple, induced by the feeding of *Pseudococcus brevipes* Cockerell is found throughout the tropics wherever pineapple is grown. It is definitely a condition which continuous growing of pineapple on the same land encourages but is rarely serious in the one-cycle culture so often practised in these areas.

In Ceylon, the mealy-bug is found attended principally by the fire ants *Solenopsis* and, as is typical in such cases, in rather isolated patches often with a huge nest built around a mealy-bug-infested plant. Even so, however, by the time the plants have fruited and slips and suckers are produced, mealy-bugs can be found on a high percentage of the vegetative planting pieces used for new plantings.

In the area near Colombo where pineapple has been planted on land cleared of old rubber and coconut plantings, mealy-bug wilt is a serious matter to many growers.

The purpose of the experiment which was performed was to confirm the diagnosis made on the basis of symptoms. In this experiment, leaves were pulled from large apparently normal plants growing in a field where patches of wilted plants were common. Gravid females of *Pseudococcus brevipes* were

caged on these leaves and after large colonies of first instar larvae had developed, these were used to infest healthy young plants by cutting out the section of leaf on which the cage had been set and dropping this into the heart of the plant, leaving the mealy-bugs to move off as the leaf section dried up.

Two months later typical symptoms of mealy-bug wilt had developed on some of the infested plants and later reports indicated that a high percentage had wilted.

The experiment was adequate to confirm the diagnosis and to demonstrate to the growers the relationship between the insect and the disease.

The fumigation of planting material, already recommended by the Entomology Section, Ceylon Department of Agriculture, would seem to be the most logical control measure for the small grower to adopt with the aid of fumigation facilities provided by the Government.

### Mealy-bug Green-spot of Pineapple

This toxic effect, localized at the insect's feeding point, was present in a mild way on pineapple leaves in Ceylon. It is a distinctly different disease from mealy-bug wilt and of no economic significance unless developed to extreme on very small plants.

Of interest from the standpoint of the geographical distribution of mealybug strains, the symbionts of *Pseudococcus brevipes* in Ceylon did not include the rod-shaped form. In this respect they are similar to specimens examined in Tanganyika and Malaya (2) and different from those in Hawaii and Central and South America. There, green-spotting is associated with the presence of various rod forms in the mycetomes of *P. brevipes* (1, and unpublished data).

### Savoy Curl of Kapok

Young kapok seedlings showing a savoy-like curling of both terminal and lateral shoots were received from an estate. The plants were infested with a mealy-bug determined as *Pseudococcus* sp. Because of this incomplete identification it can be noted that the insect produces an egg mass enclosed in an almost parchment-like sac. Its mycetome is orange-red in color and the included symbionts blunt, sausage shaped, some curled, and somewhat similar to those of *P. citri*.

The symptoms on the kapok were diagnosed as probably due to the toxic feeding of the mealy-bug and experimental evidence confirmed this, Mealy-bugs caged on young healthy kapok produced the symptoms very rapidly, and there was a clear relationship between the numbers of mealy-bugs and the severity of the symptom. When the mealy-bugs were killed by spraying with malathion, the symptom development ceased and new growth was normal.

### Summary

Cacao virus, similar in symptoms to some of the West African strains, was transmitted from cacao to cacao by *Pseudococcus lilacinus* and *P. citri*.

Mealy-bug wilt of pineapple was diagnosed on the basis of symptoms and the diagnosis confirmed by experimental infestations of healthy plants by *Pseudococcus brevipes*.

Green-spotting of pineapple leaves was found associated with *Pseudococcus brevipes* and the mycetomes of insect do not appear to contain the rod-like form present in other areas.

A savoy curl of kapok was shown to be due to the feeding of a *Pseudococcus* sp.

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# Karandagolla—A New Feature in Poultry Development

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Medical Scientists and nutrition chemists have long recognised that protein derived from animal sources has a higher feeding value than vegetable protein for human beings. It is now common practice to assess proteins on the scale of their biological values, in which proteins of animal origin rank above those of vegetable origin. While it is true that animal proteins are richer in certain amino-acids, it is also equally correct that a mixture of vegetable and animal food will furnish man with the most satisfactory diet. In Ceylon, the consumption of foods of animal origin has hitherto been below normal, but nutritionists have during recent years pointed out the necessity for increasing it in order to build a healthier and stronger population. The country is as yet far from self-sufficient in regard to foods of animal origin, and at present large quantities of animal food have to be imported to make up this deficiency. The increasing demand for animal foods is giving local agriculturists an excellent opportunity to plan their farming on a broader basis and thus stabilise their economy to a greater extent. In doing so, they have to plan not only to meet present day needs, but also to cater to the rapidly increasing human population.

The main sources of animal protein are milk, meat, eggs and fish, and while Ceylon could easily be self-sufficient in all of these, eggs are one commodity in which self sufficiency could be attained within a few years. It is true that poultry, to some extent, compete with man in their food requirements, but on the other hand it should be noted that egg production in Ceylon could be based at least in part on the left-over food from households, hotels, &c., and on the rice that is damaged during transport and storage. It is the realization of this fact that has prompted the Department of Agriculture to intensify its campaign of back-yard and small-scale poultry keeping. The recent introduction of the modern "Deep Litter" system provides an excellent opportunity for all households to produce their own requirements of eggs even when hardly any backyard space is available.

Extension work in poultry development can be carried out efficiently only if the public have access to good stock at reasonable prices. Advice and demonstration by themselves will not be of very great value unless stock can be supplied at prices that are commensurate with the return that will be obtained from the eggs produced by the stock. It is, however, not the intention of the Department of Agriculture to rear all the chickens required annually for the country, but the Department has a very important function to fulfil at the present time by making stock cheaply available to *bona-fide* breeders until

privately owned poultry farms are in a position to meet the demand. Once the private breeders are able to meet the demand for replacements for producers' flocks, or once the producers themselves become sufficiently organised to rear their own replacements, the Department's foremost role in poultry development would be to rear high producing stock with a view to raising the genetic merit of private owned flocks. Multiplication of stock would then be in the hands of private enterprise, while the Department would only be catering for occasional introduction of high producing material besides carrying out its investigations on poultry management, feeding and housing.

Until recently Ambepussa Farm was the main Poultry Station of the Department of Agricuture and it held that position for very many years. Poultry-keeping at this farm, however, had never been crowned with any great success, partly due to the unfavourable climatic conditions resulting from excessive humidity and partly due to the high incidence of disease for which the efficient drugs of today were not available. It was therefore decided about two years ago that poultry operations at Ambepussa should be abandoned, and that a new poultry station capable of handling a larger number of birds and running on more modern lines should be established in a more congenial climate elsewhere. The result was that part of the Karandagolla Division of the Kundasale Cacao Estate was taken over for this purpose. This new site offered several advantages: the rainfall was far below that at Ambepussa and was even less than that at Kandy; six of the already existing buildings on the land were suitable for conversion into poultry houses and accessories, viz., the old cacao factory which has since been converted into an excellent three-storyed brooder house, the old store which is now used as the incubator house, two bungalows for the staff and two quarters for labourers; the station was in close proximity to Kandy and Peradeniya which made transport problems and the problems of veterinary and managemental supervision from headquarters easier. The work of building up this new Poultry Station was started in earnest only after October, 1954, and it is encouraging to note that the Station is already paying good dividends in that during the last 8 months alone, it has issued or sold approximately 45,000 birds plus a large quantity of table and hatching eggs to the public.

The Station at Karandagolla was started almost entirely with imported foundation stock, only some 200 pullets being material transferred from Ambepussa. This Ambepussa stock was carefully checked several times for bacillary white diarrhoea before transfer to Karandagolla. Part of the imported material was obtained from Australia as a gift under the Colombo Plan Technical Assistance Scheme, but the bulk of it was purchased from the U. K., U. S. A., Denmark and also Australia. All the material came from recognised breeding units in the different countries. The breeds now represented at Karandagolla are R. I. R., Australorp, White Leghorn, Brown Leghorn and New Hampshire, and the flock at present consists of some 1,600 layers and about 9,000 other birds. With the gradual expansion of housing and other facilities, it is anticipated that Karandagolla Poultry Station will have a flock strength of approximately 50,000, of which about

Karandagolla Farm—General Layout

Modified Deep Litter System—Runs on either side for rotational grazing

4,000 would be layers. The large number of birds that we plan to have in the non-layer categories is an attempt to provide increasing quantities of breeding material to the public. It must also be mentioned in this connection that it is the accepted policy of the Karandagolla Poultry Station to encourage the public to purchase day-old chicks or chicks that are a few weeks old in preference to hatching eggs. It has been found by experience that the issue or sale of eggs for hatching is often a wasteful way of disseminating good stock, as hatching under small holders' conditions is rarely very efficient. It is in pursuance of this fact that chicks under five weeks of age are priced very low.

**Housing.** In spite of its being a large-scale poultry enterprise, the housing facilities at Karandagolla Farm have been designed in a manner that would permit emulation even by small holders. It is well recognised that the provision of efficient and adequate housing facilities often accounts for the major part of the ultimate success or failure of poultry keeping. This does not, of course, mean that the old method of having poultry running around the house, as we find it in rural areas, should be ruled out forthwith. On the contrary the bulk of the eggs produced in this country will almost certainly continue to come from such systems of poultry keeping. But it should be our endeavour to change peoples' ideas of poultry keeping and gradually make them adopt more efficient ways of egg production for their own benefit as well as for the benefit of the country at large. In those countries where poultry keeping has reached an advanced stage, birds are often maintained under highly artificial conditions. In fact many modern poultry farms remind one more of egg factories rather than farms. The old concepts of poultry farming have to be gradually changed to yield place to these modern systems that have paved the way for an easier and more economical method of producing eggs. In this connection the more or less mechanised " battery system " is an outstanding example of how space and labour requirements can be reduced drastically while at the same time the control of food-intake and productivity of birds can be achieved with amazing accuracy. But, of course, it is very costly to establish, it is uneconomic if the number of birds is small, and it requires very careful and efficient management as the birds have to be almost spoon-fed. A system of poultry keeping far more suitable to present conditions in this country is the modern " Deep Litter " System. It is labour saving, it requires very little space, and it does not call for a very high degree of human skill in management. Moreover, it is a system that everybody can afford to adopt.

The deep litter system and various modifications of it are in use at the Karandagolla Poultry Station. The following are the main features of the housing facilities on this farm :—

(1) One large house for layers to accommodate 2,000 birds. Here, a modified system of deep litter has been adopted in that in addition to the " deep litter " house alternate grass runs are provided for rotational grazing.

The house is divided into compartments fitted with doors which permit ready access from one end of the house to the other.

The Hatchery

Brooder House

(2) One large intensive deep litter house to accommodate 2,000 birds. The individual compartments accommodate 250 birds each.

(3) Two large intensive deep litter houses for growers (pullets). These houses, once completed, will accommodate at least 4,000 birds.

(4) Portable houses for growers and cockerels, each accommodating 150 birds. These will be shifted around in pens according to the availability of grazing.

(5) One brooder house accommodating about 5,000 chicks. Until such time as electricity is made available heat is provided to the chicks from kerosene brooders. The usual umbrella type of brooder is used, each having a capacity of 300 chicks. The house has a ground floor for bigger chicks where no artificial heat is provided, and two upper floors with heaters. All floors are divided into small compartments, and chicks are housed according to age—the newly hatched chicks being accommodated on the top floor and the bigger ones lower down. New hatches are put on clean litter (paddy chaff) in disinfected pens. No transport of litter is allowed from floor to floor, a special shaft being provided on each floor for the disposal of old litter. When electricity becomes available, there will be a large unit of electrically operated battery-brooders in which chickens would be kept on wire netting.

Brooders of this type have already been obtained under the Colombo Plan Technical Assistance Scheme from Australia.

Sexing of day-old chickens is not undertaken at the present time but equipment for the purpose has been obtained from Japan under Colombo Plan aid, and arrangements are being made to send an officer for training in this subject.

**Feeding**. All-mash rations are given to poultry at Karandagolla and these are fed as dry-mash. This system is not only labour saving but has given good results in regard to both growth rate and egg yield. The rations used are based on the results of carefully conducted poultry nutrition experiments carried out at Peradeniya during 1954-55. They are composed almost entirely of home grown feeding stuffs which are available at relatively low prices. It may be relevant to note here that the most expensive component of the rations is cereals which make up about 40 per cent. of the diet.

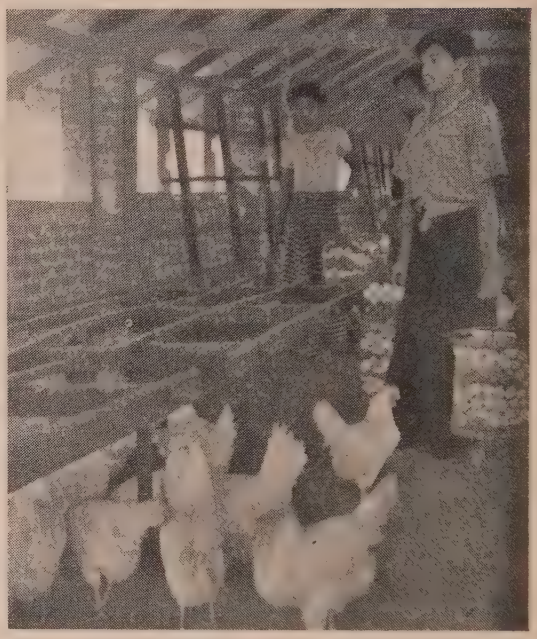
Feed troughs and other utensils suitable for feeding dry-mash have been turned out on the farm. These utensils are cheap, efficient and labour saving in that some of them are filled only once or twice weekly. Pipe water has been made available to all houses.

**Breeding.** At present, as a temporary measure, trap-nesting facilities have been provided in the layer houses. But when separate breeding pens become available, trap nesting will be carried out only for a selected number of layers, (approximately 10 per cent. of the laying flock), while all others will be provided with community nests. The breeding work would be based on combined

Artificial Heater in Brooder

Deep Litter for Growers

Trap-nesting in Deep Litter House



Egg Collection

individual and family selection and would also involve a comparsion of breeds. It has also been decided that the introduction of new stock from abroad will not be made to Departmental Farms other than Karandagolla, which will therefore serve as the supply centre of high yielding stock to other units.

**Multiplication**. The primary role of Government poultry units other than the one at Karandagolla would be to function as multiplication stations. In this connection, special reference may be made to Welisara Farm situated close to Colombo. This farm will, as far as poultry development is concerned, work in close collaboration with Karandagolla. It has already been equipped with large incubators and a number of electrically operated brooders are also being installed with a view to accommodating about 7,000 chicks at a time for issue to the public. A large "deep litter" house has also been constructed and will be used to some extent as a Demonstration unit to purchasers of breeding material.

**Disease Control.** It is appreciated that any outbreak of contagious diseases at Karandagolla could have very dire consequences because breeding material from this station is distributed to so many other Department Units and to several private establishments. A rigorous control of disease is therefore very necessary and routine vaccination will be carefully carried out. The fact that Karandagolla is so close to the Island's main Veterinary Laboratory and that Veterinary Research staff with specialized experience in poultry diseases can visit the farm frequently is therefore satisfying.

Karandagolla Farm will no doubt be of great importance to the poultry industry of this country. It will enable

the Department to carry on an efficient extension service and it could also show the way to more efficient poultry farming as a whole. It is hoped that in due course of time, a number of private breeding farms will be established and run on a sound basis so that eventually they will be able to cater to the country's needs of good breeding material. Once this happens, the Departmental Units should turn their attention to the more undeveloped areas. It is extremely important that Karandagolla Farm must always maintain a high standard of productivity so that it may serve as the source from which accredited breeders could renew their stock regularly.

Poultry farming could be developed with great benefit to this country, not only to supply food of high biological value but also to provide additional avenues of employment and to stabilize the economy of the small holder. It would be relevant to note in conclusion that with the intensive development of poultry husbandry, adequate steps should also be taken to market the produce of small holders in particular. Perhaps the solution to this problem is best found within the frame work of the Co-operative Societies. Would it be too optimistic to foresee the development of Co-operative Poultry Production and Sales Societies embracing co-operative hatcheries as well ? With this hope, we can look forward to the day when the country can boast of self sufficiency in respect of eggs. The Department of Agriculture has taken an important step in this direction by establishing Karandagolla Farm.

# DEPARTMENTAL NOTES

## EVALUATION IN AGRICULTURAL EXTENSION WITH REFERENCE TO CEYLON*

ALTHOUGH in most South-East Asian countries agricultural extension occupies an important place in the functions of the Agricultural Departments and has been carried out over a period of several years, it is only recently that the modern methods of approach and techniques in extension have in some of the countries been adopted. In the past, extension was not directed to surveys as essential preliminaries to programme planning nor was an attempt made to investigate the problems as well as the felt and real needs of the rural population. No steps were taken to formulate plans of work for each year and after their execution to evaluate from appropriate bench marks, the progress of the undertakings and the relative merits of the methods adopted.

In the early days, particularly in the Colonial tropics, extension began with the introduction of export crops which were first tested out in Botanic Gardens. Later, the need to improve what was referred to at the time as village agriculture arose and research and investigations were conducted in Laboratories and Experiment Stations. The results were then publicised through extension without passing through the test and demonstration plot stages. The extension staff attempted to introduce practices for wide use without first ascertaining their suitability over large areas or whether there was a desire on the part of the rural agriculturists to adopt these. In many cases, such efforts, without careful planning and inadequate techniques, resulted in no real progress.

In Ceylon, agricultural extension in its original form of direct advisory work began in 1904 with the formation of an Agricultural Society, as a private body with an executive Board of Agriculture on which certain Government officials were members. Agricultural Instructors, as extension workers, were appointed to advise the rural population on improved methods of village agriculture which stood in contrast to the more remunerative 'plantation agriculture' of tea, rubber and coconuts undertaken by the capitalist classes who profited by the investigations in the Botanic Gardens of the Island. The advisory work to peasants related to visits and talks as well as to the issue of printed literature, but much of this information was of theoretical value based on the scientific principles of agriculture in temperate regions.

Although the Ceylon Department of Agriculture was established in 1912, it was not until it was reconstituted by an Ordinance in 1921, that the extension workers of the Agricultural Society were absorbed and a small supervisory staff appointed. The numbers in both grades were then increased and assigned to the different agronomic zones. The objective of the extension service was the improvement of the agricultural practices of the peasants, especially with regard to food production, by the dissemination of information based on the findings that emanate from the research laboratories and the several Agricultural Stations that were opened from time to time.

With the outbreak of World War II, the food situation in Ceylon became precarious for despite the activities of the extension service, Ceylon was still dependent on other countries for more than twice the quantities of rice—her staple food—she produced. When Japan entered the scene of action in 1941, an emergency organization to undertake food production on a much wider scale than hitherto was launched; and in 1948, a Land Development Department was created to push on with the extensive cultivation of food crops. As the world food situation showed little improvement and Ceylon continued to be dependent to a great extent on food supplies from abroad, the Government

* Paper submitted for the F. A. O. Extension Development Centre for Asia and the Far East at Bhopal, India, December 1955

decided to establish a separate Department of Food Production in 1952. The extension staff recruited by the Department of Land Development consisting of Food Production Officers and Food Production Overseers were absorbed into the new Department and their numbers were increased. Most of these workers were then placed under the technical direction of the supervisory staff of the extension service of the Department of Agriculture primarily for the planning and implementation of food production programmes through District Agricultural Committees.

The programmes or strictly speaking plans of work for food production are initially prepared for each season by minor level committees with the Village Headmen as Chairmen and Field Demonstrators or Food Production Overseers as Secretaries. These programmes are then sent up to Food Production Committees with the Divisional Revenue Officers as Chairmen and the Agricultural Instructors or Food Production Officers as Secretaries. After review by these Committees the programmes are sent to the respective Agricultural Officers who collate them into overall plans for each administrative district. They are then tabled at the District Agricultural Committees for their approval. The programmes consist largely of targets for each season of extents to be brought under cultivation with specific practices or of quantities such as fertilisers to be used. At the end of each season a report is tabled at the Committees to show to what extent the targets have been achieved. This method of evaluation carried out by extension workers who themselves are responsible for the planning and execution of programmes as well cannot be regarded as reliable. For instance, extents under improved practices are at present recorded by the extension worker on his eye judgment or on the opinions of the peasants who have adopted the practices.

Improved practices, particularly from the main objective of increased food production in the country are the tangible results which are capable of evaluation by direct measurement. What is difficult is the assessment of the merits and limitations of procedures and methods, listed below, that produce the intangible results :—

(1) Advisory talks to individual peasants and lectures to groups with and without visual aids.
(2) Cinema shows.
(3) Agricultural shows and field days.
(4) Radio talks and discussions.
(5) Leaflets, posters and magazines.
(6) Competitions.

No attempt has been made in Ceylon to evaluate the results of these essentially educational techniques by such methods as opinion polls, interest checks and sampling procedures which have been used successfully for the last 15 years in the U. S. A. It is very necessary that the suitability of these methods should be examined for their application in South-East Asian countries in order that the value and relative merits of the different educational techniques that are being employed in extension can be determined in relation to their costs. It is only when a correct assessment of the results achieved with each technique is made that modifications or improvements in techniques for real progress can be made.

In addition to the above methods, procedures and techniques in extension, there are others such as facilities and inducements that make a considerable contribution to the overall objective of increased production. Mention may be made of the Guaranteed Price Scheme under the Agricultural Products Regulation Ordinance for certain crops such as paddy, chillies and onions and the subsidy scheme for fertilisers in Ceylon. It is, however, difficult to disentangle the effect of these methods from the others referred to above, but it is possible that statisticians and evaluation experts may be able to devise suitable analytical techniques for doing so.

The first attempt to introduce some of the modern methods of approach in extension was made during the years 1935-1947 when pilot villages were selected for intensive development. Considerable progress was claimed for this procedure but with the emphasis that was being placed on the production of food crops on a wide scale, it was relegated to a secondary place, but from this

year it is being taken up again. As no method of evaluating the progress made in these villages was adopted, the work undertaken was not fully appreciated.

The second method of approach was the demonstration plot introduced in 1948 for the purpose of showing the rural population in their own fields the value of certain improved practices of growing paddy such as transplanting, weeding as well as manuring both with green material and fertilisers. A large number of these result demonstrations throughout the Island was held and the yields were checked by crop samplings. The total numbers for different treatments for each agronomic division for each season were statistically examined against controls and in all cases percentage increases from 6 to as much as 119 were recorded. On the basis of these results, much publicity was given to the recommended practices for wider adoption and these then became the major projects in extension work.

The demonstration plots were in effect used as test plots in which treatments both singly and in combination were statistically examined and the results publicised. In future, new practices or findings of research will be tried out in test plots in cultivators' fields and the results statistically examined. If the treatments prove successful, they will then be adopted on demonstration plots—both to demonstrate a method or a result—without further statistical examination of results and thereafter they will become projects for adoption in the areas to which they are suitable.

Projects which are aimed at increasing the total production of paddy each cultivation season by (*a*) improving the acre yields and (*b*) extending the cultivated areas each season take priority in extension programmes. The average yield of paddy in Ceylon was estimated at 14 bushels per acre and production at about one third of the total consumption. These figures were accepted for many years and included in official records but were unsupported by any precise methods of determination. In Ceylon, as in most countries in the East, cultivators who grow paddy in relatively small areas as changing tenants on a share cropping basis will not furnish statistics of yields, &c., on questionnaires or forms. Hence the only way in which yield figures can be collected is on a random sampling basis.

In 1949, pilot sampling surveys of paddy yields were first introduced for certain districts by M. F. Chandraratne and these revealed a mean yield of 27 bus. per acre for those districts in the *yala* (south-west monsoon season). For the *yala* 1951, the mean yield for one area (Minneriya) was found to be as high as 43 bus. per acre. An Island-wide survey was then undertaken under the direction of R. S. Koshal, a F. A. O. Statistician, for the *maha* 1951-52 (North-East Monsoon Season). These surveys were thereafter continued each season and from the *maha* 1952-53 season they were undertaken by the Department of Census and Statistics with the co-operation of the Departments of Agriculture, Food Production and Administration. The results are listed below :—

| *Season* | | | *Island Average Yield per Acre Bus.* |
|---|---|---|---|
| *Maha* | 1951–52 | .. | 30·85 |
| | *Yala* 1952 | .. | 30·70 |
| *Maha* | 1952–53 | .. | 26·44 |
| | *Yala* 1953 | .. | 27·90 |
| *Maha* | 1953–54 | .. | 30·47 |
| | *Yala* 1954 | .. | 29·78 |
| *Maha* | 1954–55 | .. | 32·15 |

These figures reveal that the previous official yield of 14 bus. per acre was a considerable under-estimate due to much over-estimation of the acreage cultivated in the reports of Village Headmen. The sampling surveys were therefore used to determine both the yield and acreage of paddy. It would appear that from the bench mark record of yield from the *maha* 1951-52 season, extension work has had little effect in increasing yields. But that year was a particularly favourable one for this crop and the yield survey was, therefore, taken on the crest of the wave of fluctuating good and bad seasons. However, despite an increasing population the total production has increased

and imports decreased during the last two years as compared to 1938 when the estimated local production in terms of rice was only 150,000 tons as is seen in Table 1.

The crop cutting surveys were specifically designed to estimate the yields and acreages of paddy and any information that was collected during the surveys of agricultural practices, &c., would therefore not have the same precision. However, since the additional information flowed from as many as 2,000 samples distributed at random within the 20 districts—the number of samples in each district being in proportion to the acreage under paddy—it does provide a fair idea of the extent of the distribution of various agricultural practices over the Island.

Table 2 gives the ancillary information that was collected during the yield surveys on soil conditions and agricultural practices expressed as percentages of the total acreage cultivated.

In the case of transplanting, it will be observed that commencing with the *maha* 1951-52 season and for the corresponding seasons thereafter there has been an increase in the percentage of the area transplanted. These figures are, however, expressed as a percentage of the total acreage harvested and are therefore an under-estimate of the progress made. Since over half the area under paddy is in the drier region where mainly 4 months paddies are grown for the *maha* season and only 3 months for the *yala* season, under a system of irrigation from tanks, the response to transplanting is not as high in the wet zone where 4½ to 6 months varieties are cultivated. If the districts where transplanting is suitable are considered then the percentage of land transplanted to the area transplantable for the *maha* season would be 18-20. Weeding has also shown an increase during the *maha* seasons and when the new Japanese Weeders are more extensively used, weeding will be a more widely adopted practice.

The age old customs of hoeing (mamottying) and buffalo mudding in certain areas have shown a decline. It must be noted that in some of these areas on account of the swampy conditions of the fields there is no other alternative but to adopt hoeing for the preparatory tillage operations of the fields. But there is no reason why extension plans should not aim at the complete elimination of such primitive operations as "ploughing" with the single tyne country plough followed by hoeing and also hoeing followed by buffalo mudding.

**TABLE 1**

| *Year* | *Population* | *Production of Rice (tons)* | *Acreage cultivated* | *Imports of Rice (tons)* | *Estimated Total Consumption of Rice (tons)* |
|---|---|---|---|---|---|
| 1938 | 5,700,000 | 150,000 * | 900,000 * | 522,950 | 672,950 |
| 1952 | 7,940,000 | 380,000 | 936,000 | 399,300 | 699,300 |
| 1954 | 8,600,000 | 450,000 | 1,034,407 | 395,944 | 845,944 |

* Estimates.

**TABLE 2**

| *Season* | *Transplanted* | *Weeded* | *Well drained* | *Ill-drained* | *Ploughed* | *Hoed only* | *Buffalo mudded* | *Ploughed and Hoed* | *Ploughed and Buffalo mudded* | *Hoed and Buffalo mudded* |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Per Cent.* | *Per Cent.* | *Per Cent.* | *Per Cent.* | *Per Cent.* | *Per Cent.* | *Per Cent.* | *Per Cent.* | *Per Cent.* | *Per Cent.* |
| *Maha* 1951–52 | 4·8 | 18·7 | 82·6 | 17·4 | 59·3 | 23·7 | 13·2 | 1·6 | 1·8 | 0·3 |
| *Yala* 1952 | 2·0 | 15·0 | 82·0 | 18·0 | 55·0 | 18·0 | 19·0 | 3·0 | 4·0 | 1·0 |
| *Maha* 1952–53 | 8·3 | 24·4 | 87·8 | 12·2 | 61·5 | 18·0 | 11·2 | 2·9 | 4·9 | 1·5 |
| *Yala* 1953 | 4·3 | 9·8 | 89·1 | 10·9 | 39·8 | 20·1 | 32·2 | 2·2 | 4·7 | 1·0 |
| *Maha* 1953–54 | 8·0 | 33·0 | 83·0 | 17·0 | 73·5 | 15·5 | 10·7 | 0·1 | — | 0·2 |
| *Yala* 1954 | 3·8 | 21·0 | 83·4 | 16·6 | 56·4 | 17·9 | 18·2 | 2·0 | 4·5 | 0·9 |
| *Maha* 1954–55 | 9·3 | 30·0 | 87·8 | 12·2 | 72·0 | 14·7 | 4·6 | 2·11 | 4·2 | 2·4 |

The need for evaluating the tangible results of extension methods of procedures such as the introduction of improved practices in agriculture will be appreciated when it is realized that the extension worker himself, Government and the public need reliable evidence on the real progress made in these projects. In Ceylon, and it is believed that the same will apply to other countries in South-East Asia, evaluation surveys should be undertaken by agencies other than the extension workers themselves so that the investigations will be objectively accomplished without bias. The appropriate Department in Ceylon to carry out this work is the Department of Census and Statistics in co-operation with the Department of Agriculture and where improved practices relating to food production are involved, with the Food Production and Revenue Departments in addition. Much of the data can be drawn from the yield and acreage random surveys without much loss of precision. In the absence of such a Department in other countries of the region, special evaluation staff will be needed to work in close co-operation with extension workers.

Even in the case of the intangible results of extension efforts, the Department of Census and Statistics could undertake this work in co-operation with the Department of Agriculture.

In conclusion, it may be stated that extension work in the two essential phases of programme building and planning and then of execution is incomplete without the third side of the extension triangle, viz., evaluation which is necessary to indicate how effective planning and execution have been and what modifications are necessary to make these more effective.

W. R. C. PAUL,
Deputy Director of Agriculture.

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## REPORT OF THE VEGETABLE SUB-COMMITTEE OF THE CENTRAL BOARD OF AGRICULTURE

A Sub-Committee of the Central Board of Agriculture was appointed to go into the question of vegetable production and marketing with the following terms of reference :—

> "In view of the short supply and high prices of vegetables prevailing in most parts of the country this Board shall discuss the matter and recommend to the Ministers concerned the ways and means of facilitating the greater production, better transport, and even distribution of vegetables at a fair price to the growers and consumers."

The Sub-Committee consisted of the undermentioned :—

Mr. S. Sivapalan (Chairman)
Mr. W. M. Cumarasamy
Mr. R. T. Chelliah
Mr. S. L. B. Dharmakirti
Mr. A. M. C. Dias
Mr. D. B. Ellepola
Mr. U. B. Unamboowe
Mr. A. V. Richards (Horticultural Officer)
Mr. R. B. Thalakada (Assistant Commissioner for Co-operative Development)
Mr. L. H. Fernando (Botanist and Senior Agricultural Research Officer—Convenor).

The following is a summary of their recommendations :—

### Production

1. Wide publicity should be given to the nutritional value of locally-grown vegetables.
2. A more even distribution of vegetables throughout the year may be obtained by (*a*) encouraging off-season production, (*b*) the cultivation of vegetables that lend themselves to storage and transport, (*c*) the use of artificial methods of storage, and (*d*) improving facilities for preservation.

3. Home garden cultivation in rural and urban areas should be given full encouragement.
4. Vegetables should be cultivated in paddy land in seasons when paddy is not normally cultivated.
5. Possibilities of improved irrigation should be explored.
6. Vegetable seed raised by the Department of Agriculture should be made available at convenient places.
7. Practice in vegetable cultivation should be included in the School curriculum.
8. Fruit cultivation should be stepped up.
9. Cultivation of chillies and onions should be intensified and extended.

**Marketing**

10. Marketing of vegetable produce should improve and expand through co-operative organizations.
11. C. A. P. & S. Societies should either be allowed public carrier permits or be declared a prescribed public authority under Section 89 (i) (*d*) of the Motor Transport Ordinance.
12. Railway should provide louvred waggons with collapsible shelves for vegetable transport.
13. Grades should be fixed for the more popular vegetables and fruits.
14. Central packing facilities should be provided at suitable collection centres.
15. Need for refrigeration plants for storing surplus produce should be carefully considered.

**Organization**

16. Immediate establishment of a Board of Co-operative Marketing covering both production and marketing of vegetables is essential. The functions of the Marketing Department in this respect should be expeditiously transferred to this Board. The Board should operate under the provisions of a Legislative Act with the power to propose regulations under the Act.
17. Liberal assistance should be provided by Government to Co-operative Societies for capital expenditure.
18. Scheme of guaranteed subsidized prices should operate for graded fruits and vegetables of particular varieties.
19. Assistance to producers with planting material, manure, implements, &c., should be continued through Co-operative Societies.

# BOOK REVIEW

**Monographs on Tea Production in Ceylon, No. 4—Tea Manufacture in Ceylon by E. L. Keegel**

*Issued by the Tea Research Institute of Ceylon and printed by H. W. Cave & Co., Ltd., Colombo, 1956.*

THE MANUFACTURE of tea has come to be regarded as an art in Ceylon, depending on rules and standards acquired over long years of experience, and rarely based on the chemical and physical processes involed in converting the fresh tea leaf into the manufactured black tea demanded by the trade. Although many of the processes involved are still not fully understood, and although the estimation of quality still depends on the palate of tea tasters, the results of research, so well presented in this book, have shown that the process of manufacture is not so complicated as it has appeared to be. By correlating the day to day practical problems encountered in the factory with the chemical and physical processes involved, the writer has done a service to the whole tea industry, by placing the subject on a scientific basis and so leaving the door open for further progress and improvement.

The first chapter of the book, which deals mainly with the chemistry of tea manufacture, has made a good attempt to simplify a very difficult subject. But it is still fairly heavy reading for the layman unacquainted with biochemistry. The rest of the book is very readable, and written in language which the tea planter and the student interested in tea cultivation can readily understand. An attractive feature of the publication, which makes it very useful as a ready reference book for planters, is the appendix containing a number of very useful tables, a well arranged subject matter index, and a bibliography arranged in a manner which makes reference to specialized articles in the *Tea Quarterly* very easy.

Altogether, this book has supplied a long-felt need, and its publication is to be welcomed.

M. L. C. I.

# CENTRAL BOARD OF AGRICULTURE

**PROCEEDINGS OF THE THIRD MEETING OF THE CENTRAL BOARD OF AGRICULTURE HELD IN THE LIBRARY OF THE DEPARTMENT OF AGRICULTURE ON JUNE 25, 1956, AT 2.15 P.M.**

Dr. A. W. R. Joachim, Director of Agriculture, presided and the following were present :—Mr. Charles A. M. de Silva, Vice-Chairman, Sir James P. Obeysekera ; Mudaliyar N. M. Abul Cassim Marikar ; Mr. J. M. Sabaratnam ; Mr. A. W. R. Perera, A. C. D. M. ; Mr. W. M. Cumaraswamy ; Mr. N. R. Rajavarothiam, M. P. ; Muhandiram T. B. Ekanayake ; Mr. S. Arumugam, representing the Director of Irrigation ; Mr. G. Gunatilleke, representing the Director of Land Development ; Mr. A. G. Divitotawela ; Major Gordon Pyper ; Dissawe S. A. I. Elapata ; Mr. Ray Wijewardene ; Mr. S. Pathmanathan ; Senator B. I. Palipane ; Mr. D. B. Ellepola ; Senator E. W. Kannangara ; Mr. R. H. de Mel ; Mr. A. M. Clement Dias ; Mr. Henry Abeywickrema, M. P. ; Mr. Anton G. Ponnampalam ; Mr. S. B. Yatawara, R. C. S. ; Mr. R. H. Spencer Schrader ; Mr. W. P. H. Dias ; Mr. Lakshaman Rajapaksa, M. P. ; Mr. J. A. de Silva, Conservator of Forests, Mr. S. Srinivasan ; Mr. Arthur Weerakoon ; Mr. A. J. Joseph, C. C. S. ; Chairman, Milk Board ; Mr. M. B. Samarakoon ; Mr. M. B. Mediwake, M. P. ; Dr. E. D. C. Baptist, Director, Rubber Research Institute ; Mr. M. S. de Silva of the Education Department (by invitation), and Mr. N. P. Wijeyeratne, C. C. S., Secretary, Central Board of Agriculture.

The following Departmental Officers were also present :—

Dr. W. R. C. Paul, Deputy Director of Agriculture, Mr. T. M. Z. Mahamooth, Deputy-Director (Animal Husbandry) ; Dr. J. W. L. Peiris, Plant Pathologist ; Mr. D. V. Ariyaranayagam, Botanist and S. A. R. O. ; Mr. T. Wickremasinghe, Soil Conservation Officer and Mr. C. Charavanapavan, Assistant Chemist (Food Technology).

The following visitors were present by invitation :—

Dr. P. K. Ray, F. A. O., and Mr. L. Goonewardene.

Letters and telegrams regretting inability to attend the meeting were received from the following :—

Mr. J. V. Harbord, Tea Research Institute ; Senator Lady Molamure ; Mr. Kenneth Morford ; Mr. R. Singleton-Salmon, M. P. ; Mr. S. Armstrong, Director of Food Production ; Major E. C. de Fonseka, Permanent Secretary, Ministry of Agriculture and Food ; Mr. K. W. Devanayagam ; Mudaliyar N. Wickremaratne, Mr. C. Van Geyzel ; Mr. S. L. Bandara Dharmakirti ; Mr. P. B. Bandaranayake, and Mr. A. L. B. Pethiyagoda.

**I—Confirmation of the Minutes of the last Meeting**

Senator E. W. Kannangara inquired as to whether the minutes of the previous meeting were to be confirmed or whether what appeared in the printed booklet which were actually the proceedings of the meeting were to be confirmed ?

Chairman—" On previous occasions too this matter came up whether proceedings of the Central Board of Agriculture should be recorded in full or whether only minutes should be recorded. But it was decided that, for the advtantage of members, the full proceedings be recorded ".

Senator E. W. Kannangara—" If we are to confirm the proceedings of the meeting, I do not agree with some of the statements contained therein and, therefore, I wonder whether it is correct in our confirming them ".

Chairman—" There is a great advantage in recording the full proceedings because anybody who is interested has merely to

read through them and he gets a complete picture of the whole subject under discussion. I do not think we will bind people to every word of what has been recorded".

Senator E. W. Kannangara—"I quite welcome the proceedings of meetings in full but what I thought was that if the Secretary could prepare in minute form all the decisions taken, the procedure would be more correct".

Chairman—"May I suggest Senator Kannangara, that in view of what you say we print the decisions taken at meetings in bold type? Normally resolutions are printed in bold type although it has not been done in this instance".

Senator E. W. Kannangara—"On page 4, right hand column of the printed minutes you get the words "This was agreed to". Now, what was agreed to is not clear".

The Chairman explained that the suggestion put forward by the speaker immediately prior to the words referred to by Senator Kannangara was what has been agreed to.

Mr. D. B. Ellepola—"I have a few corrections to make in the minutes. On page 6 the word "first" topographical maps should be altered to "first class" topographical maps. The word "not" in line 7 from the bottom left-hand column appearing between the words "mapping" and "to" should be deleted. On the right-hand column of the same page, line 19 from the bottom the word "of" appearing before the word "government" should be substituted by the word "for".

Chairman—"Well gentlemen, subject to these amendments may I take it that the minutes are confirmed?"

The minutes were confirmed subject to the above amendments.

**II—Matters arising from the Minutes of the Previous Meeting**

Chairman—"There are a number of new members on the Board by virtue of their being Members of Parliament consequent on the change of Government. The following new members have been nominated to the Board: Major Gordon Pyper representing the Planters' Association, Mr. W. P. H. Dias representing Kalutara D. A. C., Mr. M. B. W. Mediwake, M. P., representing the Kandy D. A. C. and Mr. Lakshaman Rajapakse, M. P., representing the Hambantota D. A. C.

The following Members of Parliament have expressed their willingness to serve on the Board of Agriculture and their names will be sent up for nomination shortly:—Mr. M. D. Banda, M. P., Maturata; Mr. W. G. M. Albert Silva, M. P., Buttala; Mr. T. B. Subasinghe, M. P., Bingiriya, and Gate Mudaliyar M. I. M. S. Kariapper, M. P., Kalmunai; Senator S. Nadesan, Q. C., has also expressed his willingness to serve on the Board. In the circumstances we would have to make certain adjustments in the membership of our Sub-Committees. Gentlemen, would you permit me to do this at my discretion? You can be sure that I will not misuse that privilege.

Gentlemen, there is a matter which came up at an earlier meeting regarding the purchase of earth-moving tractors. This has been referred from the Ministry of Lands to the Ministry of Agriculture and Food. In the latter Ministry this question has been dealt with partly by the Director of Food Production and partly by the Director of Agriculture. I have here a note from my Chief Agricultural Engineer, Mr. Ratnatunga, which says: "I saw the Director of Food Production about this matter on Saturday when I went to Colombo for the Milk Board interviews. The Director of Food Production said that as no Colombo Plan machinery could be got this year, he intended doing this earthmoving work experimentally with the machinery he is to get for de-silting of tanks around Vavuniya. The Director of Food Production said he would explain this to the Central Board of Agriculture." Unfortunately the Director of Food Production is not here today and has sent a telegram that he is unwell. We will, therefore, postpone this question for the next meeting.

The other matter is the resolution moved by Major Fonseka regarding *Patana* Fires. This resolution was forwarded to the Land Commissioner with the following letter—"At the meeting of the Board of Agriculture held on August 22, 1955, and confirmed on

November 21, 1955, it was agreed to request the Standing Committee on Land Development to have the *patana* land in the Maha Palata district remapped for village expansion and to allocate 25 per cent. of it for village forests before the land is given to the landless. In this connection I attach herewith a copy of the minutes of that meeting and would refer to page 18 para 3 of these minutes. I shall be glad if you could kindly put this matter up for consideration at the next meeting of this Standing Committee". I have not heard anything since this letter was written, that is in February, whether this matter came up for discussion or not at the Standing Committee.

The next is a resolution moved by Gate Mudaliyar Wickremaratne about the preservation of natural pastures at Polonnaruwa. The Chairman of the Milk Board has been addressed on this matter and now that he is here, may I ask him to tell us what steps have been taken in this connection in the North-Central Province".

Mr. A. J. Joseph, Chairman, Milk Board—"Mr. Chairman and gentlemen—It fortunately happens that this was a matter which was discussed at the meeting of the Milk Board held this morning at Peradeniya. I have myself been to Polonnaruwa with the General Manager of Farms. We found that at Polonnaruwa there is an abundance of pasture lands unparalleled in any other part of the Island. We have, with the assistance from the New Zealand Government and other foreign agencies established a milk pasteurising plant on a location immediately adjoining the Welikanda Railway Station. The building has been completed and the pasteurising equipment is now being transported from Colombo. We have built a road 15 miles upwards from Welikanda to Tirukonamadu. We have also a branch road to Kandakadu branching off this road at a point 8 miles from Welikanda. We propose to have milk collection depots at Tirukonamadu and Kandakadu and we hope to collect the milk along this new Milk Board road. We have made a rough survey—largely due to your Farm Manager at Polonnaruwa—and we expect that almost from the date of coming into production we would have at least a minimum of 2,000 pints from the area and, it is not an optimistic estimate, to expect 10,000 pints within a year of going into operation.

It has been suggested to us that in this area we should pay 15 cents a pint of milk. This a very favourable price considering that milk is now distributed in Colombo at 55 cents a pint and in Kandy at 45 cents a pint. There is no exploitation since the 15 cents is outright profit to the cattle owners of Polonnaruwa area. If it becomes necessary we mean to seek the assistance of the Co-operatives in the area. We also hope to establish little milk rooms where milk would be collected once a day and preserved in cold storage to be removed by our vans. All these we expect woud be ready by December this year and it is now a trifle premature to give a realistic estimate of our production. I hope to be able to report on our progress at the next meeting of this Board when I will be able to make a more factual report".

The Chairman thanked the speaker and said that members could ask any questions if they so desired.

Mudaliyar Abul Cassim Marikar—"May I please know from the Chairman of the Milk Board whether it is contemplated to extend this scheme Islandwide?".

Mr. A. J. Joseph, Chairman, Milk Board—"As a preliminary step we would start by tapping areas where milk is abundant and where milk could be got without any exertion of effort or money. For that purpose we have established two milk collecting centres at Gampola and Nattandiya and would also be establishing collecting centres at Hatton, Polgahawela, Tamankaduwa and, possibly, Galle. Once we have covered these sectors, I think we have covered the best milk producing areas in the Island. When that is done, with the work that is being done by the Department of Agriculture in livestock and animal husbandry development, other areas which are at present producing but little milk would have thrived and will be ready for similar establishment of milk collecting centres and pasteurising plants. In other areas like Batticaloa which might not now be prolific in milk, we may not have the need to introduce any heavy installations on pasteurising plants but facilities for cold storage will be available".

Senator Ivor Palipane—"What is the position of those who buy milk in Polonnaruwa itself ?".

Mr. A. J. Joseph, Chairman, Milk Board—"Sale of milk in Polonnaruwa is negligible but the need, such as it is, will be met".

Mr. W. M. Cumaraswamy—"There are dairy owners who maintain their herds in a scientific manner and who always see to it that the milk is of the prescribed standard. Do you think that the standard of milk you purchase at 15 cents is comparable to that? The milk so collected is definitely of a lower standard so that it is not fair that the producers of quality milk should also be paid the same rate as others".

Mr. A. J. Joseph, Chairman, Milk Board—"There are prescribed standards which are universally applicable. The price paid for milk, however, varies from area to area. In Colombo we pay 42½ cents per pint and we distribute to consumers at 55 cents a pint. In reality, as it should be in a national scheme of this nature, the producer in rural areas will eventually subsidise the suburban producer near Colombo and other big towns as otherwise the latter will ultimately get wiped out. In this way we intend to bring down the price of milk, as in some European countries to about 06 cents a pint. The Milk Board will help by collecting milk from cheap sources".

Mr. W. M. Cumaraswamy—"The Department of Health is very scrupulous about the standards they prescribed for milk and if those standards are adhered to, I do not think you can collect milk at 15 cents".

Mr. N. P. Wijeyeratne, Secretary, C. B. A.—"I would like to quote an example of the Co-operative Society at Bomiriya. There the members collectively take responsibility for adulteration. If by subsequent checking, a supplier is found to be guilty, one week's payments for what he has supplied is held back. Special arrangements are made by the Milk Board to carry out this check".

Mr. W. M. Cumaraswamy—"I am talking with some experience as President of a Co-operative Society. We even got a pasteurising plant installed by the Department of Agriculture with the kind consent of the Director of Agriculture. We got this equipment from the U. K. Adulteration can never be checked unless each individual supply is tested".

Mr. C. A. M. de Silva, Vice-Chairman—"Is the standard of the milk required by the Milk Board purely dependent on pasture?"

Mr. R. H. Spencer Schrader—"The quality of milk is more a matter of breeding than feeding. The fat content of the milk of a Fresian cow is not the same as that of a Jersey cow. The solution to that problem is, if there is a Co-operative Society, the Society must check the milk received from each individual supplier. As far as the Milk Board is concerned, it will check the milk from the Co-operative Society. The Milk Board cannot be expected to undertake the testing of milk from each individual supplier to a Co-operative Society".

Mr. Anton C. Ponnampalam—"Sir, you are now buying milk at 15 cents for your collecting centres. What is your depreciation for machinery, &c? The Marketing Department too started some mills and bought paddy when the price was Rs. 8 and Rs. 12 respectively. Subsequently the Marketing Department mills had to close down due to keen competition. In the same way if you do not contract for a regular supply, say at least for five years, then Government will stand to lose and you might even have to close down the establishment".

Mr. A. M. Clement Dias—"I am glad to hear that Polonnaruwa is able to supply milk at 15 cents. Before Mr. Joseph joined the Milk Board, it was promised that Polonnaruwa would supply 300 bottles of milk to Colombo and after some time it was found that the milk so sent was getting spoilt. Then an epidemic of hoof and mouth disease broke out in the area and the supply was stopped altogether. Therefore, if you try to get milk from Polonnaruwa at 15 cents and send to Colombo, it will be a through failure as it is sure to be well watered".

Mr. A. J. Joseph—"Much of the milk that was sent from Polonnaruwa to Colombo at that time was not pasteurised as the plant had broken down. It was only boiled".

Mr. W. M. Cumaraswamy—"I would like to know from the Chairman, Milk Board, whether pasteurisation removes adulteration ?"

Mr. A. J. Joseph, Chairman, Milk Board—"It does not! If you put water into a pasteuriser, it will produce pasteurised water and not pasteurised milk!"

Chairman—"Now that we have had a fairly long discussion on this subject, I would like to introduce you to Dr. P. K. Ray, F.A.O. Adviser in Crop and Stock Insurance who will speak to you on his subject. I met him in Rome during an assignment I had with the F. A. O. There I came to know that he was the F. A. O. specialist dealing with crop and stock insurance problems. I brought this to the notice of my Minister and Permanent Secretary and as a result Dr. Ray is here today. He will be with us for about two months during which time he will have an opportunity of meeting members of the Sub-Committees on Paddy and Animal Husbrandy and will thus be able to acquaint himself with our problems".

Dr. P. K. Ray—F. A. O. Adviser on Crop and Stock Insurance—"Mr. Chairman and Gentlemen, I feel extremely happy to have this opportunity of addressing an august body like yours. I also convey the sincere appreciation of my Director-General—the Director-General of the Food and Agriculture Organization of the United Nations—to the Director of Food, the Director of Agriculture and all others concerned for having sought the co-operation of F. A. O. for studying the problems of Crop and Livestock Insurance in Ceylon. These two subjects have been considered by F. A. O. since a resolution was passed in 1953 at a Far Eastern Regional meeting held in Bangalore. At that meeting Ceylon was also represented. This resolution asked F. A. O. to consider the subjects and make a study of their actual application at the present time and find out the practicabilities of introducing them in the so-called under-developed countries. Following that, I was asked by the Director-General of F. A. O. to take up the study of these two subjects and prepare two papers on them. I do not know whether some of you have seen the two papers I am referring to as some copies were sent to member Governments Summaries of these two documents were published in the "Monthly Bulletins of Economics and Statistics" published by F. A. O.

The above studies on Crop and Livestock Insurance were made keeping in view mainly the problems of the underdeveloped countries and in making them I had an advantage. As I come from one of these so called under-developed countries, I knew the difficulties and the intricate problems of adopting both crop and livestock insurance in such countries. Before undertaking the studies I had of course the opportunity of examining the actual working of these systems in the United States and also in various countries of Europe including Germany, Sweden, Denmark and Italy. Since we made these two studies we have received queries from a number of countries of the Far East as also from many Latin-American countries. Some interest was shown by Japan which has already been operating both crop and livestock insurance for some years. Some Latin American countries, e.g., Mexico and a few others are also making a start of crop insurance.

When I had the opportunity of discussing the subjects with Dr. Joachim in Rome, he told me about the interest of his Government in them. When we got the request of the Government of Ceylon officially, F.A.O. got an opportunity of examining the practical possibilities of both crop and livestock insurance with particular reference to one specific country at least. That is what I have come here for. Of course, I have just started my investigations. You yourselves would be aware of the difficulties, particularly about the much needed satistical data regarding crop failures and also the incidence of mortality among cattle and other livestock. So far as crop insurance is concerned, as you all know, Mr. Idaikkadar after his return from Japan made a very rough sketch of the lines along which a study could be undertaken for this country and I am at the moment examining it very carefully. I have had of course only five days to look into all these matters and I cannot say what my recommendations would be at the end of the two months' assignment I have come for. I, however, welcome the opportunity of meeting you and expect to

have your guidance, especially as a brief report was prepared by one of your Sub-Committees sometime ago about crop and livestock insurance, which I have read. Of course no decision was taken on the subjects but still I was glad to learn that they had already been considered by you. If any amongst you have any suggestions to make with regard to them, I shall very much appreciate having them for my work and study. In case you have any, please pass them on to Dr. Joachim and he would be pleased to send them on to me.

For the time being I do not have a lot to say about the need for insurance. I may say that this is a matter for you to decide. Whether or not crop and livestock insurances are needed has to be decided by each country. Of course the expert is there to point out their practical possibilities including their financial implications. But whether they should be undertaken has to be decided by Governments and interested peoples of the countries concerned. As far as I am concerned, however, I believe that for under-developed countries some form of insurance at some stage or another will be necessary in order to protect the farmers against various forms of accidental crop and livestock failures. It is necessary not only for the interest of the farmers themselves but, agriculture being the occupation of nearly 80 per cent. of our people, the interest of the entire country is vitally connected with it. The wealth of the farmers ultimately means the wealth of the country and the community and the prosperity or adversity of farmers are certain to have implications at budgetary level through taxation and other measures. We may make various provisions for safeguarding the interests of farmers, for example, by means of a guaranteed price scheme, &c. But what about the protection of farmers in the production stage? That is an important point which a body like yours and of course the Government has to decide, that is, if the farmers need some protection in the earlier stage of production against factors on which they have no control or have only little control.

But when we speak of insurance, there are different forms of insurance—the commercial type which is run for profit and the Co-operative and State Insurance—both crop and livestock insurances are run, to some extent, on a commercial basis and also as co-operative and public enterprises, especially in some of the advanced countries of Europe as well as in the U. S. A. Particularly insurance against loss of crops due to fire and hailstorm has been practised in many of the European countries, in one form or another, practically for over 150 years. When I visited some of these institutions, I was really surprised to find that they were working so successfully. But of course problems in our countries are somewhat different, and for that reason it certainly needs much greater attention and greater care. I hope I will be able at least to be of some service to your country in this connection. Thank you, Mr. Chairman ".

Chairman—" I wonder whether you would like to ask Dr. Ray any questions. Perhaps we may invite him to the next meeting of the Board. That will probably be the better time to ask questions ".

**III—Report of the Sub-Committee on Vegetable Production and Marketing**

Chairman—" The next item on the agenda is the discussion of the Vegetable Sub-Committee report. Those on this Sub-Committee deserve our appreciation and thanks for having presented such a useful report on vegetable production and marketing. The Chairman of that Sub-Committee was Mr. S. Sivapalan. He is not on the Board now. The Convenor of the Sub-Committee Mr. L. H. Fernando, Botanist, and S.A.R.O., is also away from the Island on a scholarship. But we have with us a very active member of the Sub-Committee, Mr. Ellepola, and I shall be grateful if he will be so kind as to review the report for the benefit of the members ".

Mr. D. B. Ellepola—" First of all I think the Sub-Committee owes an apology for delaying the Report. We did not want to set out everything in detail but merely outline the decisions. We later decided that in view of the time taken on this report and as most of the information would be very useful, we should try and make our report as comprehensive as possible. The signatories to the Report of this Sub-Committee include

two Government officers, an Assistant Marketing Commissioner and a Co-operative Officer. They have signed the report subject to the position that the views expressed against or in relation to their respective Departments are not their individual views but those of the Committee. As you know there was an earlier interim report issued by this Sub-Committee on this same subject. That interim report was presented sometime ago to the Board. The present report embodies the position as reviewed after that and include or varies the decisions of the earlier report. This could therefore be regarded as the final report of the Sub-Committee. The interim report need, therefore, not be taken into consideration at this stage. The terms of reference of our Sub-Committee were : " In view of the short supply and high prices of vegetables prevailing in most parts of the country this Board shall discuss the matter and recommend to the Ministers concerned, the ways and means of facilitating the geater production, better transport, and even distribution of vegetables at a fair price to the growers and consumers. " In accordance with these terms of reference, the Committee considered what really was included in the category of vegetables. As you know, there are vegetables such as Jak, Breadfruit, Manioc, &c., which are also commonly referred to as vegetables. But in view of the fact that they generally take the place of the main staple diet, rice, we decided that they should be excluded from our report and that vegetables should be divided into two main categories, leafy vegetables and non-leafy vegetables. We have in Appendix B of the report given a full list of local vegetables with their chemical composition and nutritional values, vitamin content, &c. That information has been embodied because we thought that it would be most useful. In evidence, based on detailed information, it was ascertained that leafy vegetables were much more nutritious than non-leafy vegetables. The Committee also considered that apart from the nutritional value of vegetables, consumption of vegetables would also depend on the tastes of the consuming population. Non-leafy vegetables were divided into five different groups : (1) Bandakka, brinjal, tomato and capsicum, (2) Red pumpkin, ash pumpkin, cucumber, (3) Snake gourd, bitter gourd and veta-kolu, (4) Cowpeas and beans, (5) Ash plantain, &c. Therefore in regard to the improvement in the production of those varieties of vegetables which were nutritionally high in value, we recommended in page 4 the steps that should be taken. " Mr. Ellepola reviewed the Report in great detail in this manner and explained every aspect of it to the Board.

Chairman—" Thank you very much, Mr. Ellepola, for your most comprehensive and excellent review. Now we know from whom most of the ideas embodied in the report have come, as otherwise he would not have been able to explain every aspect of it in such great detail ".

Senator E. W. Kannangara—" Mr. Chairman and Gentlemen, I want to endorse the recommendations made in this report. I am thankful to Mr. Ellepola for the very able manner in which he has just given us a summary of the report and the Committee has made a very good job of it by giving useful statistics, &c. In 1933 I had the privilege of being Secretary of the then Minister of Agriculture and Lands, the late Mr. D. S. Senanayake. I think that the establishment of a Marketing Department originated then. It was Mr. D. S. Senanayake who pointed out both to Mr. Campbell and Mr. Basset that in areas like Wellawaya and Tissamaharama, for lack of proper marketing facilities the producer hardly got anything worthwhile. Mr. D. S. Senanayake was therefore very keen that a Marketing Department should be established and that something should be done to see that the producer got a fair and reasonable price for his produce and that the middleman did not exploit him. The Marketing Department did very good work at that time but unfortunately now the Department has gone on other lines by being contractors for Hospital supplies and other Government contracts. The real idea for which the Department was established has gone to the background. Therefore, I think the recommendations in this report need careful consideration by Government and I fully endorse that a co-operative organisation covering both production and marketing of vegetables should be established and that vegetable marketing should be brought under a special board.

The Marketing Department does very good work on certain lines, for overseas trade, &c., but I think to fulfil the present needs it should work under the direction of a special board. The real headache about the Marketing Department came when the papers reported the prices of vegetables that suddenly shot up recently. I think the real reason was lack of proper marketing facilities.

I fully support the recommendations made in this Report and I thank the Sub-Committee and Mr. Ellepola in particular for the able manner in which he has reviewed the report ".

Mr. A. G. Divitotawela—" I am grateful to Mr. Ellepola for the review of the Report and for the recommendations made by the Committee. I come from Welimada area. As you know the recommendations made in the last page of this report, I would like to state that about 18 years ago we started a Co-operative Society for vegetables in the Udapalata. About 80 per cent. of our members were at that time in debt to traders. These traders advance the money and vegetable growers who take advances from them are forced to supply their vegetables to these traders. Now that the C. A. P. & S. Society has come into being there, growers do not get indebted to traders, but the difficulty about transport is there. Our difficulty, as Mr. Ellepola stated, is that lorries are licensed to transport vegetables from Palugama and Welimade to Colombo but the lorry has to return empty from Colombo. According to Mr. Ellepola's recommendation, we might be able to bring back something else from Colombo other than vegetables. I would like that recommendation to go up to the Ministry so that we could expect some sort of redress.

The other point is that about 80 per cent. of our Udapalata area depend on English vegetables. We have made a submission to the Minister that for four months in the year import of English vegetables into the country should be banned so that we might find a ready market for our vegetables. The submission has been made but nothing has been done as yet. I would, therefore, like this Committee to consider this matter and recommend to the Minister that import of English vegetables from India into this Island be banned for 4 months in the year ".

Mr. Anton C. Ponnampalam—" As an amendment to the suggestion of the last speaker I would like to state that whatever vegetables are brought from the producer should be purchased at the purchasing centre ".

This suggestion was not favoured by the Board and it was dropped.

Mr. D. B. Ellepola—" This question of stopping the import of vegetables from India for a certain period in the year came up before the sub-Committee. The Committee felt that if there was sufficient production of vegetables in the country and if the proper transport of such vegetables was assured imports of vegetables would automatically stop, which was better than imposing a ban. The remedy lies in our own hands ".

Senator E. W. Kannangara—" If the transport of vegetables from the various areas is properly organised, a shortage of English vegetables will not arise and the imports of vegetables will then automatically cease.

Mudaliyar N. M. Abdul Cassim Marikar, " Mr. Chairman and Gentlemen—I stand today with pleasure not to praise the Convenor or the members of this Sub-Committee but to express my very great pleasure because we as a Board have given our attention to this important matter of the proper use of vegetables grown in our Island. This is not the first time that we have considered this matter. At the last Board a Sub-Committee went into this matter at length but no finality was reached. But today we are really grateful to the initiative taken by the members of this Sub-Committee in particular and the members of this Board and the last Board. I should make special reference to the Director and the officers of the Agricultural Department who were responsible for initiating the work in this direction.

I have known Mr. Ellepola very well for a number of years. He is a man who was very closely connected with the agricultural advancement of the peasantry of this

Island when he was serving under Government. Even today his interest is in that direction and he has been able to devote his time and this Sub-Committee has produced such a comprehensive report which is worthy of note. I am sure the Ministry concerned will go into this matter fully and will not take much time to see that the recommendations in the report materialize so that we could reap the benefits of it before long. I am thankful to the members of the Sub-Committee and the Board for being able to produce such a valuable report but there are one or two points I wish to clarify before it is submitted.

The first point is that in our effort to produce vegetables if we are faced with a situation for lack of water, the Irrigation Department should come to our rescue and find out ways and means of getting the water and adopt necessary measures to meet such a situation instead of saying that the requests for water cannot be met.

The other point is that I wish to support this idea of Co-operative Marketing. The principle of co-operation is a very laudable thing. If anybody disagrees with this idea of co-operation, I do not know what he is about. Co-operation is a thing that brings wealth and prosperity to the country. Today we are in a position to organize the entire marketing of vegetables by a Co-operative organization. If there is going to be such a set-up, I will be the first person to support it. We know that for an organization of that nature we require a large amount of money. Without sufficient funds we cannot organize this set up. I would, therefore, suggest that in our recommendations we state that while we recommended a set up for marketing of vegetables on co-operative lines, we impress upon Government the necessity to allocate funds for its implementation.

I would also like to state for your consideration that although you may have embodied it in your report, we should sufficiently stress the fact that where there is no land for the cultivation of vegetables or where there is no water for its cultivation, vegetables should be transported from surplus areas into such areas.

I do not like to take much of your time and I would once again thank the members of the Sub-Committee and the Board for the useful literature and the recommendations submitted in regard to this matter of production and marketing of vegetables."

Chairman—"I would like to give the representative of the Marketing Department an opportunity to express his views on this subject".

Mr. A. W. R. Perera, Assistant Commissioner of Marketing—"Mr. Chairman and Gentlemen, I represent the Marketing Department and I was co-opted as a member of the Sub-Committee that drafted this report. But I wish to have it placed on record that I did not sign this report. There was one recommendation in the report which we as a Department could not comment on. That was the formation of a Board to take over the vegetable industry in this Island.

The other recommendation with which we could not agree was the suggestion to offer a price guarantee for vegetables. Apart from these two recommendations, Sir, the Marketing Department is in full accord with the submissions made in this report. The Department has been in the vegetable industry for about 20 years. It has practical experience in vegetable marketing for about 20 years. Several of its senior officers have been abroad to study vegetable marketing systems prevailing in some of the leading countries. Vegetable marketing is a highly specialized and a complex process. Vegetables do not form a commodity that can be preserved. It is because of this reason that marketing becomes a problem.

Well, Sir, it is in the light of our experience and on the background of experience that we say that a price guarantee on vegetables is not practicable and is unsatisfactory. For a price guarantee to be effective on any commodity, that commodity must satisfy at least one of three essentials. The first essential is that to give a price guarantee to any commodity, that commodity should be able to stand storage. We should be in a position, Sir, to recover its cost either

in its original form or under cold storage. Vegetables do not stand to this requirement. We can only deep freeze vegetables. For that we should have deep freeze transport facilities also. Deep freezing of vegetables is uneconomical and you will see that vegetables do not qualify to that essential too for a price guarantee.

Secondly, to give a price guarantee to a commodity we should be able to process it as in the case of pineapples, mango, &c., which are canned. But in the case of vegetables we cannot do it. In New Zealand apples are dehydrated but dehydration of vegetables will not suit our palate. In the case of a commodity like milk, when there is an excess of it, it can be turned into butter and cheese. But vegetables cannot be processed in this manner.

The third essential a commodity can satisfy for it to be given a price guarantee is that it should be in short supply and be imported into this country in large quantities, e.g., green gram, &c. In the case of red onions we can give a price guarantee because it can be preserved for one reason and for another we can always hand it over to an importer for distribution locally. Vegetables should satisfy at least one of these three requirements for a price guarantee to be given. On the other hand, Sir, if we price guarantee certain varieties of vegetables, the producer will grow only that variety of vegetables which is price guaranteed and there would be a shortage of the other varieties. It is for these reasons, we are unable to agree to a price guarantee. After all, vegetables are not in short supply. So long as the capitalist system is working in this country, a high price in one season for a particular variety of vegetables will mean more production of that variety during the next season. So long as the capitalist system continues, we must allow the price mechanism to function and any interference with a price guarantee especially in the case of vegetables is dangerous and also unsatisfactory.

Then, Sir, as regards the suggestion that the Marketing Department should be handed over to a Co-operative Organization, the original intention of Government was that the vegetable marketing scheme should finally be handed over to a co-operative organization and it is with that aim that the Department is working at present. Today, all the vegetables and fruits that are given to us by Co-operative Societies are bought by us and we do not function in those areas where Co-operative Societies function satisfactorily. It is for the House to decide whether the Co-operative movement of this country is in a position today to take over the vegetable marketing scheme run by this Department. We as a Department are always prepared to give our fullest co-operation and the benefit of our experience to any scheme that would improve the price to the producer and reduce the price to the consumer.

Coming to the question of Marketing Boards I would say, Sir, that I have studied the Marketing Boards that are now established in the various States in Australia and New Zealand. These Boards are empowered to function under the Producers' Marketing Act. The Minister in charge declares an area to be governed by the Marketing Act and appoints a Marketing Committee for a particular commodity. Thereafter the Committee takes over the output, sale and the other activities connected with the commodity. I have always observed that Marketing Boards have been formed for those items which had an exportable surplus or those items which could be processed into some form or those items which should be produced in large quantities and which were in short supply in the country. I do not think, Sir, that vegetables satisfy any of these conditions.

In the interim report of this Sub-Committee it was stated that there was a serious shortage of vegetables in this country. I said it was not so and that to find out the correct position, statistics should be obtained. When statistics were collected there was no shortage. In Australia when I questioned the authorities why there were no Marketing Boards for vegetables, they said that Marketing Boards were not necessary to protect the local producer from the local consumer. So long as sufficient

safeguards were taken to see that the vegetables collected conformed to certain standards and the activities of the commission agents were controlled, there was no necessity for a Board to intervene.

In reply to a question by Senator Palipana, Mr. A. W. R. Perera, Assistant Commissioner of Marketing said that the Marketing Department intervened if it was found that the middlemen got into a ring in order to keep down prices to the producers. So long as the middlemen paid a reasonable price to the producer there was no necessity for anyone to intervene. The Department, however, bought its requirements from producers and so tended to keep up the prices to the producers. Sometimes, on Ministerial direction we offer minimum prices for vegetables. With Ministerial authority, the Department bought all the radish that was offered to us during a certain season as there was no market at all for this item at the time and we even gave this item free to certain institutions. The loss we incurred was met from a small Government subsidy.

Mr. M. B. W. Mediwaka, M. P.—" Today the retail price of salad tomato is 80 cents a pound whereas in Colombo, it is Rs. 1.20 a pound ".

Mr. A. W. R. Perera, Assistant Commissioner of Marketing—" Due to the recent disturbances in the country, there was a dislocation of transport and that was how the prices of vegetables shot up in price. Although the papers gave publicity to certain prices that were prevailing in Colombo, most of it was exaggerated, and the Marketing Department sold its vegetables even at that time at the usual prices ".

Mr. J. M. Sabaratnam—" Sir, In connection with the main recommendation of the Report, I would like to make one suggestion. The Marketing Organization was to be an interim organization till such time as Co-operatives were able to take over. I would, therefore, suggest that we first of all assign the function of purchase of vegetables which is now being done by the Marketing Department to the New Board. There is always the possibility that there might be a certain amount of dislocation before all activities are taken over from the marketing section by a co-operative organization and as a result the producer will be badly affected. I would therfore suggest that the Board should have under its control the activities of the Marketing Department regarding purchase, transport and distribution of vegetables throughout the whole Island so that the Marketing Department can gradually move out of areas when the co-operatives have taken over. It will be good if the whole of the Marketing Department could come under the purview of the Board. It will be then possible for officers of the Marketing Department with their experience in the marketing of vegetables to be of some assistance in the actual execution of the project ".

Referring to a point raised earlier in the discussion, Mr. A. W. R. Perera, Assistant Commissioner of Marketing stated—" We have made a recommendation that the import of cabbages be banned for four months in the year when sufficient quantities of Upcountry vegetables are available, and the Ministry is taking action in regard to that ".

Chairman—" Gentlemen, now that this matter has been discussed at length, may I know whether members are in general agreement with the proposals made in the report, or whether there are any others who would like to express their views on the report? The Marketing Department, of course, will get an opportunity of expressing their views in regard to the proposals in the report when it is forwarded to the Ministry ".

Mr. D. B. Ellepola—" First of all, may I say that the Committee had before it the benefit of Mr. Perera's (Assistant Commissioner of Marketing) views. after giving the fullest consideration to all that he had to say, the Committee finally decided that it should express its views to the Board in the present form. Therefore, the Committee's observations are not without prior knowledge of the standpoint of the Marketing Department.

The next point I would like to refer to is Mr. Perera's statement that there is no shortage of vegetables. Statistics do not prove that there is no shortage of vegetables. On the basis that four ounces of non-leafy vegetables, two ounces of leafy vegetables and four ounces of fresh fruit per day should be consumed by each person as the minimum essential requirements for a well-balanced diet, which is the advice of the Nutrition Experts, we came to the conclusion, that the present consumption of vegetables per head of population being well below that level there is a shortage of vegetables. Therefore, the presumption in the original resolution is quite correct that there is a shortage of vegetables, in the sense that people are not consuming sufficient vegetables.

In regard to the point about shortcomings of co-operative societies and their not being prepared to take over, I would not wish to dilate on the shortcomings of the Marketing Department. I would say that those who live in glass houses should not throw stones at others. I know the type of work that co-operative societies do and I also know that there are numerous difficulties in their way. In the experience of all of us there are various shortcomings in the Marketing Department too, but it is not our duty to investigate into the shortcomings of that Department. Co-operative societies themselves have shortcomings. It is not that the position is any better or worse in the one case or the other. We do not want to draw comparisons. We live in an age of democracy when we have to manage our own affairs.

The question of price guarantees has been mentioned. Yes, as it is, it will not be possible for the Department of Marketing to give a price guarantee. But a Board will be able to take decisions in a far freer atmosphere. The Board itself will have a secretariat functioning, but that secretariat will not take decisions as at present. The Board may take the decision that certain commodities shall be price guaranteed, in certain areas, during certain seasons. A price guarantee is essential in order to give a fillip as well as a protection to the producers of vegetables. We disagreed with Mr. Perera that a price guarantee was not possible. This scheme of a price guarantee is really a subsidisation, and there is no question of a profit. Government may lose on a price guaranteed scheme but might gain on the other hand in various ways which may well balance the financial losses.

Then, regarding the point that a price guarantee is not possible because vegetable storage is not available, the solution may well be quick transport from one area to another. There need not be storage facilities everywhere. In certain varieties and in certain seasons there might be an excess but it is conceivable that this difficulty can be overcome.

This Board will define areas and will decide what commodities should be collected and how long the price guarantee shall operate.

In regard to the question about the period of transition, we do not visualise many difficulties. I do not know whether it would be possible for the activities of the Marketing Department to be brought under the directions or guidance of a Board. There is no parallel where a Government Department is brought under the control of a Board. But what the Board could do is to move in stages over a period of time building up its own organisation. We must understand that the Marketing Department is ours and the Board we contemplate is also ours. We are out to get the best possible results for the benefit of the country, and in the course of transference, as assured by Mr. Perera himself, there would be wholehearted co-operation and if that co-operation is forthcoming the transference can be done in a manner that will fully accord with our needs. I hope that explanation will meet the point raised by my friend from Jaffna. I would suggest to this Board, that if it agrees with the general trend of the proposals in the report, specific details as to how each proposal could be implemented can be worked out. So that there need not be any fear that straight away the co-operatives will be asked to take over. The Co-operatives will be asked to say whether they can undertake this work and only when they are in a position to take over will this suggestion be implemented".

Senator E. W. Kannangara—"I suggest that this report be submitted to the Minister of Agriculture and Food for consideration and implementation".

Mudaliyar Abdul Cassim Marikar—"I second the proposal that it be forwarded to the Hon'ble Minister".

Chairman—"I thank the Committee and particularly Mr. Ellepola for having explained the report to the members of the Board. It has been suggested to me that this report be published as a Sessional Paper. I would, however, like to leave it to the Ministry to so determine. Thank you all very much for this discussion which has been most fruitful of result.

I must make an apology to Mr. Schrader for the omission of his resolution from the agenda. This was brought up at the last meeting which he could not attend. By an oversight, it was not included in the agenda for this meeting and in the circumstances I propose to take it up at this stage".

**IV.—Resolution moved by Mr. R. H. Spencer Schrader**

"THIS BOARD RECOMMENDS TO GOVERNMENT THAT THE BY-LAW IN THE VILLAGE COMMITTEE ORDINANCE RELATING TO THE TAX ON DAIRY COWS BE REPEALED."

Mr. R. H. Spencer Schrader—"Mr. Chairman and Gentlemen, I do not propose to take any time at all with regard to this resolution. I have circulated my memorandum. All I wish to do is emphasise that milk is as much an agricultural product as paddy, tea or coconut. We are, therefore, asking the Board to pass a resolution requesting Government to rescind the regulation relating to tax on dairy cows.

The other point I wish to make is that it seems very absurd that a dairy farmer with about 25 cows has to pay a tax up to a maximum of Rs. 100 while any other commercial activity like a fibre mill in the village pays a maximum of Rs. 25. Those are the points I wish to emphasise and would like the Board to pass this resolution."

Mr. M. B. W. Mediwaka, M. P.—"I second that resolution".

Sir James P. Obeysekera—"Village Committees frame their own rules. I do not think Government should intervene in such matters".

Mr. Anton C. Ponnampalam—"Production of milk is treated as a commercial undertaking. But if you keep a cow at home and use the milk for your private use, the Village Committee will not tax you. It is good that these dairies are taxed because the people in the village do not get any benefit out of the milk produced as all that is marketed out. I do not think Mr. Schrader has got the Ordinance correct. I am a member and Chairman of a Village Committee. These are covered by a Village Committee Act. The Village Committees do not specify the licence fee. The Minister has definitely laid down by regulation that the Village Committees can by resolution include certain trades for licensing purposes. Subsequently the recommendation of that Village Committee is forwarded to the Ministry. The Ministry approves it and gazettes it under the name of the Minister and not under the name of the Village Committee. Therefore, at the time a Village Committee proposes to legislate the licensing of dairies, it is up to the people in that area to protest. I don't think it is possible to repeal these regulations as suggested. I think we are trying to take away a certain right given to a Local Body. In a democratic country the villages must be governed by their representative members. We will be infringing on the rights of local bodies when we say that a certain regulation should be repealed. I can definitely say that every Village Committee exercises that power of licensing certain trades carried out in that area".

Senator E. W. Kannangara—"I am, to some extent, responsible for some of the regulations in the Village Committees Ordinance which were framed at the time I was Commissioner of Local Government and Secretary to the then Minister of Local Government. The previous speaker is quite right when he pointed out that these regulations are approved by the Minister and gazetted under the Minister's name. It is not every Village Committee that passes by-laws

of this nature. Some do and some do not. In areas they do, probably they must be doing it on good reason. This Board should not intervene unless there is something very, very serious in the domain of Local Bodies like Village Committees, Urban Councils, Town Councils and Municipalities. That will be against the very root of democracy. In almost every Village Committee by-laws of this nature are passed but as the last speaker pointed out it is up to the people of that village to protest against such by-laws and if their protests are not heard by the members of the Village Committee they should at a following election return a new set of members ".

Mr. M. B. W. Mediwake, M. P.—" There is another difficulty, that is, when you obtain a licence from one local authority, other local authorities do not recognise it and they insist on another license ".

Mr. W. M. Cumaraswamy—" According to this Ordinance, I am exempted from the penalty of paying a tax as long as my cows do not produce any milk, but no sooner they produce milk and if I sell the milk, I have to pay an additional tax. Then where are we in regard to the matter of food production. We have to pay one tax for acreage, another tax for food production, another tax for milk production. If I don't produce the milk I do not have to pay. If I try to help the food front of the country, I am taxed ".

Senator E. W. Kannangara—" If the milk you produce is given free you will never be taxed ".

Mr. W. M. Cumaraswamy—" If people who protest against this enforcement of a licence fee are asked not to pay and others are asked to pay, it is not fair. A local body should not have the right of discretion of dishing out favours ".

Mr. R. H. Spencer Schrader—" Take for instance tea, rubber or any other commodity. Village Committees do not tax the sale of that produce. On the other hand if I run a dairy on my farm and I sell the milk, then I have to pay an acreage tax as well as the agricultural products tax ".

Mr. R. H. de Mel—" It is difficult for Village Committees to carry on unless they have some form of revenue. I think we should not interfere with their methods of getting the revenue. I do not think that this is a fair argument. Village Committees can do nothing to increase their revenue. The argument that because you pay an acreage tax, you should be exempted from paying this tax is unfair in principle. After all, you do not pay on your coconuts to the Village Committee nor do you pay on your rubber to the Village Committee ".

Mr. Anton C. Ponnampalam—" In the case of some Village Committees the tax is levied by the Central Body. Some are taxed by the Village Committee. Village Committees entirely live on the grants given by Government. It is not revenue of its own ".

Mr. R. H. Spencer Schrader—" My point is that milk is an agricultural product and also as it is a food, it should not be taxed just as milk foods imported into the country are duty free ".

Mr. D. B. Ellepola—" I think a principle is involved here. The Ordinance does no more than give certain powers to the Village Committees. As has been said here, agriculturists pay a tax not only on acreage but even if you have a copra kiln, in some areas, you have to pay a separate tax. So that it is purely a matter within the decision of each particular Village Committee to impose a tax in respect of dairy farms or any other activity according as they may decide. Therefore, this Board should not recommend that a certain provision in the Ordinance should be removed. If we do that I think that this Board is overstepping its powers ".

Major Gordon Pyper—" We like this motion because tea estates will stand to benefit. We pay a factory tax, we pay an acreage tax and we also pay a tax under the Food Production Ordinance. Last year we were able to commute the Food Production tax and supply milk to collecting centres on the estate. We rather feel that as we are helping the Milk Board we should not be taxed again ".

Senator Ivor Palipana—" I am a paddy producer. I pay a 'suvandiram' to the Village Headman. I pay income tax and I also pay a tax to the Irrigation Department. So

if you take a hypothetical case, I own tea, rubber and a copra kiln, I am taxed on the rubber roller, I pay an acreage tax and I have also to pay the income tax. This is a democratic country, Sir. We are now growing from our infancy to manhood, and all these various bodies are manned by members who have been elected to various bodies by the people of those areas. If they as the representatives of the people think that certain conditions should be imposed for the good of their locality, as a democratic country we should not interfere with such taxation. We must accept that this is the correct procedure. I, therefore, respectfully submit that we should not support this motion for the simple reason that we are interfering with the right of local bodies ".

Mr. Henry Abeywickreme, M. P. and Parliamentary Secretary—" Regarding the point raised by Mr. Mediwaka about double taxation by different local authorities which do not recognise licenses or certificates issued by another authority. I think it is a wrong policy. It was the first Village Committee Chairman at Udagampalata Korale who moved that bicycles be licensed. That licence should be recognised by other local authorities. Similarly if a dairy is registered in one particular area, other areas should recognise that licence ".

Mr. N. P. Wijeyeratne, Secretary, C. B. A. —" With reference to Mr. Mediwaka's problem, double taxation can be avoided if the Commissioner of Local Government can be persuaded to take it up with the local authority concerned.

In regard to the point brought out by Mr. Schrader, the grouse is not about the question of taxation but in respect of excessive taxation. I personally feel that it will be appropriate if we ask the Commissioner of Local Government to use his discretion and advise local authorities of a rate which would be fair and reasonable. Such a recommendation would not be beyond the competence of this Board because it pertains to the efficient functioning of the livestock industry.

Most dairy owners find that standards fixed by local bodies are rather arbitrary and it is difficult to conform to the standards prescribed. I, therefore, suggest that this Board solicits the aid of the Commissioner of Local Government in regard to the question of standards also.

In fact, most dairy owners who are required by Local Government by-laws to conform to standards which are difficult, find a way out by selling their milk to vendors who obtain a vendors' licence. The cattle owners would in that case not violate any law, and the vendor, even though the milk is not hygienically produced, does not commit an offence if he conforms to the requirements of a vendor. I am personally aware of such instances.

I, therefore, suggest that the Board recommends to the Commissioner of Local Government that standards required for registration of dairies and also taxation on a fair and reasonable basis be considered ".

Senator E. W. Kannangara—" This Board is one that represents the whole Island which should take up general questions pertaining to agriculture, agricultural production, etc. This is an individual case. Out of the 401 Village Committees about 200 may be levying these taxes. I do not know whether the Board of Agriculture should take up individual cases ".

Mr. D. B. Ellepola—" If we are to pursue the line of action suggested by the Secretary before we can do so, I would ask whether on the material before us we can say that there is in the Island an excess charge in respect of these taxes which would justify an appeal to the Commissioner of Local Government to review the position. What I think is, there is not enough material on which to generalise this question, as a recommendation of the Board ".

Chairman—" I would like to suggest that this matter be taken up by the Animal Husbandry Sub-Committee of this Board. The Sub-Committee could discuss this matter and see what action is most appropriate in the circumstances. Will Mr. Schrader agree to this suggestion ? "

Mr. R. H. Spencer Schrader agreed to this suggestion.

**V—Resolution moved by Mr. S. Srinivasan, D. R. O., Vavuniya South**

(i) "THAT THE SUBSIDY GRANTED BY GOVERNMENT FOR THE CONSTRUCTION OF WELLS IS TOTALLY INADEQUATE COMPARED TO THE TOTAL COST OF COMPLETING A WELL IN THE VAVUNIYA DISTRICT. THIS BOARD REQUESTS GOVERNMENT TO INCREASE THE SUBSIDY TO AT LEAST 50% OF THE COST OF CONSTRUCTION".

Mr. S. Srinivasan—"I have myself dug a well in the Vavuniya District and found that it had cost me over Rs. 4,000. The average cost of constructing a well in that area is about Rs. 2,000. The subsidy given by Government is now Rs. 400. As far as Vavuniya District is concerned the difficulty is that we encounter rock and the blasting of the rock costs about Rs. 100 per foot. Actually the cost of construction varies from Rs. 2,000 to Rs. 3,000. There may be areas where Rs. 500 is adequate but in our area the rainfall is very low and only once in 2 or 3 years do we have a fairly good rainfall and cultivation made a success. Today the only salvation for the people in that area is some source of water from these wells. We try and encourage highland cultivation because of failure of paddy cultivation due to shortage of water. I feel, therefore, that especially in the dry zone, sinking of more wells should be encouraged and I would urge upon the members of this Board to recommend to Government that the subsidy given should be in relation to the construction of a well in the area. This Board might recommend to Government that the discretion of increasing the subsidy may be vested in the Government Agent of the area".

Mudaliyar Abul Cassim Marikar—"I would like to second that motion and say that I was one of those who gave notice of such a motion in the last Board and I do not know what happened after that. I have great pleasure in supporting this motion".

Mr. D. B. Ellepola—"Professor Farmer who carried out extensive surveys in regard to the availability of subterranean water has said in his report that it is almost impossible to depend on subterranean sources especially in the N.C.P. and in areas like Vavuniya. He said that we are virtually trying to do the impossible. I feel therefore that a survey should be undertaken to investigate what should be done to raise the water table in these areas".

Mr. S. Srinivasan—"I would not like this problem to be mixed up with other problem. Geological surveys, etc., will take time and we can go into that matter sometime later. But as far as Vavuniya District is concerned, I have told you that wells are the only salvation for the people of that area. People in that area get an opportunity of doing good cultivation only once in three or four years. We have only to dig the wells and blast any rock that we may encounter. In fact we are able to get a perennial supply of water if we dig deep down. The question of finding the water does not arise".

Mr. S. Arumugam, representing the Director of Irrigation, in response to a query from the Chairman said—"We cannot contribute anything vital to the topic because our work has been on surface storage. Mr. Farmer is, I understand, conducting a scientific study of water levels in N. C. P. Any way this has no relation to the subject at issue. The two subjects would appear to be different. One is a study of a scientific report on the availability of water, and the other concerns the amount given for constructing wells which have already been dug and which is found to be insufficient".

Chairman—"Now that you have already expressed your views on this matter and moved your resolution, would you prefer to leave this matter till the Director of Food Production is present for a discussion".

Mr. S. Srinivasan—"I have no objection".

The two subjects are entirely two different things. One is a scientific study of a report on the availability of water, and on surface storage. The other is that the amount given for constructing wells is insufficient and he wants more money".

Chairman—"Now that you have already expressed your views on this matter and moved your resolution, would you prefer

to leave this matter till the Director of Food Production is present for a discussion ? "

Mr. S. Srinivasan—" I have no objection ".

**VI—Resolution moved by Mr. S. Srinivasan, D. R. O., Vavuniya South**

(ii) " THAT THE FOOD PRODUCTION DEPARTMENT BE REQUESTED TO PLACE THE JUNGLE CLEARING AND ROCK BLASTING MACHINERY AT THE DISPOSAL OF THE FARMERS TO ASSIST IN QUICKER AND MORE EFFICIENT DEVELOPMENT OF LAND FOR FOOD PRODUCTION ".

Mr. S. Srinivasan—" Speaking again for the dry zone, every year large acreages of land are being alienated to the people and especially due to shortage of labour, they are unable to clear the land. Now modern machinery is available for clearing land expeditiously. In fact, if manual labour is used, it takes three to four years to develop the land fully but if D. 8 tractors or some such machinery are used, the land can be brought under cultivation in the same year and the land can be tractor ploughed. In this way if the Food Production Department can supply efficient machinery on a hire basis, farmers will be greatly benefited ".

Mr. A. C. Ponnampalam—" I wish to second that resolution. I would emphasise that we are not capitalists and we are not able to invest money on heavy machinery. If the Government or a Department under Government can undertake to import this machinery, there is a possibility that people will be able to do their work without difficulty and they will work for this country during their lifetime. Such heavy machinery should be available to us so that we can pay a nominal hire ".

Mr. D. B. Ellepola—" I would like to suggest an amendment to that motion that the words ' at the disposal of the farmers ' be substituted by the words ' at a nominal hire ' ".

Chairman—" Do you agree that this resolution be accepted as amended ? "

The mover and seconder had no objection to the amendment.

The resolution as amended was accepted.

**VII—Resolution moved by Mr. Ray Wijewardene**

" THAT IN VIEW OF THE NEED TO ENCOURAGE THE CONSUMPTION OF A MORE BALANCED DIET (PARTICULARLY PROTEIN) IN CEYLON AND ALSO IN VIEW OF THE GREAT NEED TO DEVELOP NATURAL PADDY FERTILISERS, THE AVENUES AFFORDED THROUGH THE USE OF THESE PARTICULAR FORMS OF UNICELLULAR ALGAE, CHLORELLA AND TOLYPOTHRIX BE THOROUGHLY INVESTIGATED BY THE FOOD TECHNOLOGISTS AND MICRO-BIOLOGISTS OF THE DEPARTMENT OF AGRICULTURE ".

Mr. S. Pathmanathan in seconding the resolution read out the following memorandum on the subject prepared by Mr. Ray Wijewardene :—

" The part played by unicellular algae in food production and crop husbandry has been little understood until recently when the need for increasing the production of food and raising crop yields has warranted deeper research into the fields of micro-biology. Two strains of algae have particular importance to us in Ceylon. They are Chlorella and Tolypothrix. I shall first deal with Chlorella and the part it plays in food production.

One very well established point in population studies in all forms of animal life is the fact that population shows most rapid increase among species consuming poor and inadequately balanced diets—the main dietary shortage which appears to contribute to increased rates of population being protein —so lacking in the diets of the Indians, Ceylonese, Chinese and other rapidly multiplying races of the East. Inadequate diets were the main causes of the alarming increase in population in the European countries about a century ago. Since then diets have improved. These nations are now more worried about the declining trends in population.

With this in mind research workers in Japan and America have been working on other sources of diet—some from the sea, others from lakes and ponds, and about the most promising of them all is the culture

of the variety of Algae called "Chlorella" which is very rich in protein and vitamin, drawing most of its energy for growing from the sun, and multiplies so rapidly that 40 tons of Chlorella can be grown per year in every acre of land given over to Algae culture—the equivalent of 20 tons of protein in comparison with the production rate in agriculture, where soya beans (the world's highest protein containing crop), produces protein in the bean at the rate of less than ½ a ton per acre per year!

Chlorella can be cultivated in open tanks, with slight agitation, and equipped with circulating pumps which feed in the nutrient and harvest the cells. Production is continuous and harvesting can also be a continuous operation—as the Chlorella which looks like a green slime can be separated in a centrifuge, washed and dried into a powder which may be mixed with other foods as a protein concentrate. The components of Chlorella cells by weight are :—

| | |
|---|---|
| Protein .. .. | 42% |
| Fat .. .. | 22% |
| Carbohydrate .. | 24% |
| Ash .. .. | 12% |

Vitamin content per gram of dry weight is—

| | |
|---|---|
| Vitamin A .. | 5000 International units |
| Vitamin B1 .. | 4 $\gamma$ |
| Vitamin B2 .. | 21 — 28 $\gamma$ |
| Vitamin B3 .. | 9 $\gamma$ |
| Niocin .. | 176 $\gamma$ |
| Folic Acid .. | 485 $\gamma$ |
| Vitamin C .. | 2,000. 5,000 International units |

A fundamental step however would be to ascertain whether Chlorella can conveniently and palatably be incorporated into the diet of our people, and I suggest that samples of the Chlorella powder be brought in from Japan and experimented with particularly in conjunction with curries, as a vegetable protein concentrate. Should it be palatable and beneficial, then research may be undertaken into its production locally which would have none of the problems faced in the temperate countries, the main one being low temperatures during the winter months. Our year round temperatures of around 85 degrees F. and strong sunlight are as near as possible perfect for Chlorella culture. It must be remembered that if research on a subject like this is left until the need for it is really felt, it may then be too late!

*Algae for Fertilizers*

During the war, the Japanese realised their stocks of nitrogen fertilizers could not meet the demand, as they were falling very low and could not be met by local production. They therefore decided to make use of the Blue Green Algae which are known to fix atmospheric nitrogen in the form of ammonia, believed to be the form in which the paddy plant takes its requirement of nitrogen. This Algae often observed as a sort of scum on paddy fields had not until this time been investigated, and research workers were sent to all parts of the occupied far east to collect samples of Blue Green Algae. Two varieties were found most promising (*Tolypothric tenuis* from Borneo and *Calothrix bravissima* from the Palau Islands) of the 643 varieties collected and examined for nitrogen fixation. It was found in field tests that the total nitrogen fixed by Tolypothrix during a cultivation season was about 25 lbs. per acre, thus eliminating the need for a top dressing.

After the fields are drained, the Algae can be preserved in a small pool or tank and fed on their favourite (phosphatic) diet until the next season. If the lands are damp or moist, the Algae will live on the ground until the next rice growing season. The thick scum left by the Algae on the soil after the fields have been drained for harvesting also add very considerably to their organic content when turned in, and this factor is one of particular interest to us in Ceylon, with our soils so low in green or organic matter. In this manner, the Japanese have found increases in yield in the subsequent crop of up to 20-30 per cent. due entirely to the residual fertility left by the Algae. The Japanese keep culture of their particularly high nitrogen yielding Tolypothrix and Calothrix in volcanic earth and bagged in Pilythene packets ready for distribution to farmers who need them.

It is felt that research should be undertaken in Ceylon to isolate high nitrogen fixing strains of Blue Green Algae for distribution to paddy farmers, particularly as

we have no local source of inorganic fertiliser, and very limited resources of organic fertiliser.

Dr. J. W. L. Peiris, Plant Pathologist—"Both these subjects do not fall within my purview. I think a certain amount of work has been done on Nitrogen fixation by Tolypothrix by the Botanist and Senior Agricultural Research Officer and he will be able to tell you something about it. As far as Chlorella is concerned, this is a new subject to us. The Germans started work on this subject during the war and subsequently it has been followed up in America and they have found that this organism has a very high percentage of good quality protein. But, however, it is expensive to recover this protein because the plant costs a great deal. If it could be produced more economically, it can be used. As far as the food value of this is concerned, I think the Food Technologist of the Department will speak to you on the subject".

Mr. C. Charavanapavan, Food Technologist of the Department—"I have read some literature on the subject but I do not know whether it is suitable for human consumption. If a sample is made available, it could be tested at the Medical Research Institute to see whether it is suitable for human beings. It all depends whether protein in Chlorella is of a high biological value as a body building material. Torula yeast has been found to be high in protein of high biological value and B vitamins. This product can be used as tabloids. In the same way Chlorella can also be used as a source of protein and vitamins if it is proved to be rich in protein of high biological value and vitamins".

Mr. Ray Wijewardene—"I have tasted a preparation of it myself in Japan and I found it extremely pleasant and I feel that it should be encouraged here".

Mr. D. V. Ariyanayagam, Acting Botanist and Senior Agricultural Research Officer—"As mentioned by Mr. Wijewardena, Japan and India have already done a lot of work on this subject and *Tolypothrix tenuis* and *Calothrix bravissima* were found to be efficient nitrogen fixers in Japan. In addition species of Nostoc and Anabaena were also found to fix small quantities of nitrogen. We have already started work, about 6 months ago, on this aspect of the problem. In the first place we are carrying out an all-Island survey of the blue green algae found in paddy fields. I have enlisted the help of Range Agricultural Instructors, Food Production Officers and Farm Managers to collect specimens from all over the Island. These specimens are being identified at Peradeniya. The species found in Ceylon are mostly Nostoc, Anabaena and Oscillatoria. In all, over 15 different genera have been identified. The survey is not yet complete.

Secondly the effects of the growth of blue green algae on the yield of paddy are being investigated in field experiments at Batalagoda, Tissamaharama and Paranthan. Thirdly the blue green alga *Tolypothrix tenuis* is being maintained in culture at Peradeniya. This will be multiplied and the effect on paddy will be determined in pot and field experiments when sufficient quantities are available".

Chairman—"I would advise Mr. Wijewardena that the Department has already made a start in regard to the development of natural paddy fertilisers. The Botanist's Division are conducting the field trials with algae and, thereafter, the Food Technologist will, in consultation with the Biochemist of the Medical Research Institute, investigate the possibilities of their use for human consumption. You must, of course not expect results immediately".

Before we break up, I would like to state that I have spoken to Mr. de Silva about his resolution relating to the high cost of poonac. He says that if it could be considered by the Animal Husbandry Committee, he would be satisfied".

**VIII—Reports of Sub-Committees of the Board**

Chairman—"I have to report that the Paddy Sub-Committee has done a good deal of work. I suggest that this Sub-Committee's report should be circulated, as it is a very valuable and useful one. There are matters like the failure of the guaranteed price scheme dealt with in it. I think this is a

matter which deserves a full discussion and I suggest that it be taken up at the next meeting of the Board as the first item for discussion.

As regards the Minor Products Sub-Committee, they have had just one meeting. There is nothing very much they can report just now.

As regards the Animal Husbandry Sub-Committee, a meeting proposed to be held was cancelled as it was not possible for several members to attend on the date fixed. This Sub-Committee should meet as early as possible as there are a number of items to be discussed. Will Dr. Mahamooth please see that an early date is fixed for the meeting? "

Dr. W. R. C. Paul, Deputy Director of Agriculture—" Col. Murray is investigating the question of agricultural education. After Col. Murray submits his report at the end of July, the Sub-Committee will go through that report and make their observations ".

The meeting terminated at 5.50 p.m.

N. P. WIJERATNE,
Secretary,
Central Board of Agriculture.

Peradeniya, July 14, 1956.

# METEOROLOGICAL REPORT

## April-June, 1956

### SUMMARY

THE EASTERN and north-eastern parts of the Island experienced dry weather again in April, completing seven successive months of unusual drought conditions. Consequently, there was an acute shortage of water at many places in these regions, causing grave hardship to man and beast and extensive failure of agricultural pursuits. During April the weather was mainly of the intermonsoon type. Winds were chiefly light, while days, and even nights occasionally, were uncomfortably warm. Although afternoon and evening thunderstorms commenced about the 8th, the accompanying rainfall was generally scattered, and was mainly confined to the central parts of the Island and the south-western regions. These conditions were in evidence till the 26th. On the 27th the weather became unsettled on account of a low pressure wave and continued so till the end of the month. Strong south-westerly winds were widely experienced, with heavy rain which was mainly confined to the south-western parts. The rainfall has heaviest on the 28th when about 30 stations recorded daily amounts over 5 inches. On account of this rain there was a monsoonal pattern indicated in the monthly distribution of rainfall (somewhat similar to that of May). The monthly rainfall was heaviest in the south-western mid-country, where a number of stations recorded totals over 20 inches, the highest being 30.32 inches at St. George's Estate (Matugama). From this region there was a rapid decrease in rainfall, monthly totals outside the south-west quarter being chiefly below 5 inches. The rainfall was least in the Northern and Eastern Provinces, where the totals were below 2 inches. The rainfall was well above normal in the south-western low and mid-country, several stations recording excesses over 5 inches. It was below normal in the northern and eastern parts as well as in the hill-country. The greatest deficits occurred among the Haputale Hills and neighbourhood, as these regions did not receive their normal quota of evening thundershowers this year. There were about 50 daily falls over 5 inches most of which occurred during the period of unsettled weather. The highest were 9.44 inches at St. Vincent's Group (Maggona) on the 25th and 9.17 inches at Sirikandura Estate on the 26th.

Although monsoon conditions prevailed over the Island during May, the winds were unusually dry. Consequently, the rainfall experienced was only moderate. At many stations, even though the number of rain-days was about normal, the total rainfall received was less than half the average. Further, depressional activity which is also a normal feature during May was conspicuous by its absence. On account of this, the rainfall was mostly confined to the south-western parts. In the northern and eastern parts therefore the weather was again warm and dry, thus completing a very long period of eight months of unusual drought conditions. At many stations in these regions the rainfall received during this period (1955 October to 1956 May) was less than half the average, deficits being of the order of 25 to 30 inches. The actual amounts recorded at some of the stations were, 24.53 inches against an average of 54.17 at Vavuniya, 23.11 inches against 49.55 at Anuradhapura, 28.20 inches against 61.84 at Polonnaruwa, 34.51 inches against 70.49 at Maha Oya and 26.53 inches against 53.25 at Nuwara Eliya. As the monsoon is now well established and the rainfall chiefly confined to the south-west quarter, the hopes are remote for the northern and eastern parts to expect rainfall to any appreciable extent for another two or three months. The larger monthly totals during May were of the order of 15 to 25 inches only, and occurred on the south-western slopes of the hills, the largest being 23.99 inches at Kenilworth Estate. Elsewhere in the south-western parts the rainfall ranged from 5 to 15 inches. In the northern and eastern parts the monthly receipts were below 2 inches,

about 80 stations in the Northern, Eastern and North-Central Provinces receiving no rain at all. The rainfall was below normal practically throughout the Island. Greater deficits, of the order of 10 to 15 inches, occurred in the south-western low and mid-country, the greatest deficit being 23.05 inches at Carney Estate (Palabaddala). Elsewhere in the south-western parts and in the hill-country the deficits were of the order of 5 inches. In the northern and eastern parts the deficits were small because of small averages.

Active monsoon weather prevailed over the Island during June, rainfall being mainly confined to the south-western parts. In the south-western hill-country moderate rain was experienced almost daily, with frequent gusts of strong south-westerly winds. On a few days the rainfall was fairly widespread on account of unsettled weather caused by low pressure areas in the Arabian Sea. These rains extended to the north-central parts on the 13th, and to the eastern and north-eastern parts on the 17th and 18th, while they were widespread on the 22nd and 23rd. On the above days the rainfall was considerably heavy in the south-western hill-country and many daily falls over 5 inches were recorded. As a result, Kelani Ganga rose to near minor-flood level, while floods were experienced in Kalu Ganga and Mahaveli Ganga. On the 12th a violent thunderstorm in Hingurakgoda area caused considerable damage to house and property. Heaviest rain (which occurred in the south-western hill-country) ranged from 40 to 50 inches, the highest totals being 53.53 inches at Watawala and 53.47 inches at Kenilworth Estate (Ginigathena). From this region the rainfall decreased gradually towards the coast, monthly totals in the south-western low country and in the neighbourhood of Kurunegala and Matale being of the order of 15 inches. At the south-western coast stations, however, the rainfall was less and amounted to only about 5 inches. In the north and the east the monthly totals were mainly of the order of 2 to 3 inches only. The rainfall was considerably above normal in the south-western hill-country, where the excesses at many stations exceeded 10 inches. It was generally above normal elsewhere over the Island too, except in the western and south-western low country. Deficits in some parts of the south-western low country ranged from 2 to 5 inches. There were more than a hundred daily falls over 5 inches most of which occurred on the 17th, 18th or 22nd. The highest were 11.52 inches at Watawala and 11.09 inches at Kenilworth Estate on the 18th. A hailstorm was reported from Haputale on the 11th.

D. T. E. Dassanayake,
Director of Meteorology.

| Station | April | | | | | | | | | May | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Temperature | | | | Humidity | | Rainfall | | | Temperature | | | |
| | Mean Maximum | Offset | Mean Minimum | Offset | Day | Night (from Min. Temp.) | Total | Offset | No. of Days | Mean Maximum | Offset | Mean Minimum | Offset |
| | ° | ° | ° | ° | % | % | in. | in. | | ° | ° | ° | ° |
| Anuradhapura .. | 95·1 | +3·5 | 74·6 | +0·2 | 62 | 93 | 2·50 | —3·93 | 8 | 93·3 | +2·5 | 76·6 | +0·2 |
| Badulla .. .. | 87·0 | +2·9 | 66·6 | +0·4 | 66 | 92 | 6·13 | —0·87 | 16 | 88·0 | +2·5 | 65·3 | —1·1 |
| Batticaloa .. .. | 88·7 | +0·8 | 76·7 | 0 | 72 | 88 | 0·64 | —1·66 | 7 | 92·9 | +2·6 | 78·1 | +0·3 |
| Colombo .. .. | 88·0 | +0·2 | 76·2 | +0·4 | 75 | 91 | 11·46 | +2·39 | 14 | 85·7 | —1·3 | 78·4 | +0·8 |
| Diyatalawa .. | 80·9 | +3·1 | 61·0 | +0·5 | 70 | 89 | 6·81 | +0·27 | 16 | 80·2 | +1·5 | 61·9 | —0·1 |
| Galle .. .. | 86·0 | 0 | 76·5 | —0·2 | 78 | 88 | 15·24 | +6·53 | 14 | 83·5 | —1·5 | 77·7 | —0·4 |
| Hambantota .. | 88·1 | +0·5 | 77·1 | +0·9 | 77 | 89 | 2·47 | —1·39 | 9 | 87·6 | +0·8 | 77·6 | 0 |
| Jaffna .. .. | 89·5 | —0·1 | 81·4 | +1·2 | 71 | 79 | 1·30 | —0·93 | 2 | 86·7 | —1·4 | 81·2 | —0·5 |
| Kandy .. .. | 88·1 | +0·4 | 69·6 | —0·4 | 63 | 87 | 2·11 | —3·89 | 12 | 83·9 | —2·1 | 70·3 | —0·3 |
| Kankesanturai .. | 92·3 | — | 79·4 | — | 72 | 89 | 2·42 | +0·88 | 3 | 91·4 | —0·5 | 81·0 | —0·5 |
| Kurunegala .. | 91·4 | +0·4 | 75·3 | +0·7 | 67 | 93 | 9·68 | —0·23 | 10 | 88·2 | —1·0 | 76·7 | +0·6 |
| Mannar .. .. | 91·4 | +1·4 | 79·9 | +1·9 | 75 | 89 | 0·76 | —2·66 | 3 | 88·6 | —0·9 | 81·4 | +0·6 |
| Nuwara Eliya .. | 72·6 | +1·4 | 49·8 | —0·2 | 72 | 87 | 4·40 | —0·58 | 11 | 68·3 | —2·1 | 55·9 | +2·6 |
| Puttalam .. .. | 90·4 | +1·1 | 77·1 | +0·2 | 68 | 86 | 3·46 | —0·42 | 10 | 88·8 | +0·4 | 79·6 | +0·7 |
| Ratmalana .. | 88·9 | — | 76·4 | — | 70 | 88 | 14·18 | +3·61 | 12 | 86·9 | —0·4 | 78·8 | +0·9 |
| Ratnapura .. .. | 91·4 | +0·2 | 73·7 | 0 | 68 | 88 | 11·40 | —0·17 | 17 | 88·8 | —0·2 | 74·7 | —0·2 |
| Talawakele .. | 76·4 | — | 56·6 | — | 80 | 94 | 5·01 | —1·29 | 18 | 71·2 | —4·5 | 59·2 | —0·7 |
| Trincomalee .. | 93·5 | +4·3 | 79·0 | +1·4 | 64 | 82 | 0·84 | —1·29 | 8 | 96·8 | +4·6 | 80·3 | —1·5 |

| Station | May (contd.) | | | | | June | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Humidity | | Rainfall | | | Temperature | | | | Humidity | | Rainfall | | |
| | Day | Night (from Min. Temp.) | Total | Offset | No. of Days | Mean Maximum | Offset | Mean Minimum | Offset | Day | Night (from Min. Temp.) | Total | Offset | No. of days |
| | % | % | in. | in. | | ° | ° | ° | ° | % | % | in. | in. | |
| Anuradhapura .. | 60 | 88 | 0·30 | —3·24 | 4 | 90·7 | +0·7 | 75·6 | —0·8 | 65 | 88 | 1·86 | +1·13 | 10 |
| Badulla .. | 60 | 92 | 0·34 | —4·35 | 3 | 85·1 | —0·3 | 66·4 | +1·0 | 65 | 92 | 1·62 | +0·08 | 10 |
| Batticaloa .. | 65 | 76 | 0·10 | —1·69 | 2 | 90·6 | —1·7 | 77·2 | —0·5 | 65 | 80 | 3·31 | +2·42 | 9 |
| Colombo .. | 79 | 86 | 4·61 | —10·88 | 22 | 84·0 | —1·4 | 77·1 | —0·2 | 81 | 89 | 4·90 | —3·76 | 21 |
| Diyatalawa .. | 62 | 84 | 1·04 | —5·02 | 10 | 74·6 | —3·0 | 62·6 | —0·6 | 66 | 81 | 4·01 | +2·05 | 22 |
| Galle .. | 84 | 89 | 4·52 | —8·15 | 19 | 81·9 | —1·7 | 75·8 | —1·4 | 85 | 88 | 9·96 | —1·52 | 21 |
| Hambantota .. | 79 | 89 | 1·17 | —3·10 | 9 | 86·7 | +0·3 | 76·5 | —0·3 | 78 | 86 | 1·41 | —0·70 | 14 |
| Jaffna .. | 78 | 83 | 0 | —2·00 | 0 | 86·3 | —0·4 | 79·7 | —1·2 | 79 | 82 | 2·71 | +2·32 | 7 |
| Kandy .. | 65 | 82 | 4·34 | —2·17 | 14 | 80·4 | —1·8 | 70·5 | —0·1 | 73 | 82 | 11·54 | +4·24 | 23 |
| Kankesanturai .. | 69 | 82 | 0 | —1·49 | 0 | 89·9 | —1·3 | 79·0 | —2·0 | 71 | 86 | 4·73 | +4·16 | 6 |
| Kurunegala .. | 70 | 84 | 3·50 | —4·05 | 14 | 85·0 | —1·6 | 75·3 | —0·3 | 78 | 88 | 16·91 | +10·12 | 19 |
| Mannar .. | 76 | 83 | 0·09 | —1·70 | 1 | 87·0 | —1·2 | 79·4 | —1·2 | 76 | 85 | 2·02 | +1·66 | 4 |
| Nuwara Eliya .. | 80 | 85 | 3·60 | —4·87 | 17 | 64·4 | —1·2 | 56·0 | +0·3 | 86 | 88 | 24·54 | +14·11 | 27 |
| Puttalam .. | 69 | 80 | 0·63 | —3·14 | 5 | 87·0 | +0·6 | 78·3 | —0·9 | 71 | 82 | 2·95 | +1·55 | 8 |
| Ratmalana .. | 73 | 82 | 3·96 | —12·45 | 24 | 85·0 | —0·5 | 77·5 | +0·1 | 78 | 82 | 6·53 | —2·45 | 20 |
| Ratnapura .. | 71 | 88 | 9·10 | —11·81 | 26 | 85·8 | —1·0 | 74·3 | —0·4 | 78 | 88 | 25·05 | +6·50 | 30 |
| Talawakele .. | 91 | 94 | 4·98 | —4·43 | 19 | 67·7 | —3·1 | 59·6 | —0·8 | 93 | 100 | 26·21 | ÷12·93 | 25 |
| Trincomalee .. | 51 | 74 | 0 | —3·23 | 0 | 92·2 | —0·1 | 78·5 | —1·6 | 58 | 78 | 1·70 | +0·77 | 5 |